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5 August 1985

USSR Report

MACHINE TOOLS AND METALWORKING EQUIPMENT

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USSR REPORT

MACHINE TOOLS AND METALWORKING EQUIPMENT

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Moscow EKONOMICHESKAYA GAZETA in Russian No 20, May 85 p 20

[Article by Professor G. Stroganov. doctor of technical sciences, deputy chairman of the USSR Gosplan and deputy director of the Soviet section of the CEMA Committee On Cooperative Machinebuilding. "Machinebuilding Is the Leading Area of Cooperation: CEMA -- Integration in Action"]

[Text] Machinebuilding is the fastest-growing branch of the national economies of the socialist community. In the years 1950-1985, the total share of machines and equipment produced in the CEMA nations increased about 35 times while overall industrial growth went up about 13 times. At the present time, our economies turn out about 25 percent of the world output of machines and mechanical equipment. In many respects, this production by CEMA nations is leading the world.

Active cooperation and coordinated work among the CEMA nations is making an ever-greater contribution to the development of their machine-building industries. On the basis of over 220 agreements on specialization and cooperative production involving over 15,000 appellations and standards in machine building, The USSR is cooperating with its fraternal nations.

In the realization of these agreements, the Soviet Union has imported from other CEMA nations part of the equipment it needs for oil and gas refining, metal-working equipment and different technologies for agriculture, transportation (high-speed electrical passenger trains, isothermic and passenger wagons) and vessels for its marine, river and merchant fleets. In turn, the USSR is supplying the CEMA countries with heavy-duty mining and underground transport equipment, road-building machinery, tractors, automobiles and other types of machinery.

A New Impulse to Cooperation

An economic high-level meeting of the CEMA nations gave new impulse to productive cooperation of our nations in all directions including machine-building. This meeting emphasized the need for comprehensive cooperation aimed at providing key industries with high-quality advanced machinery and equipment.

The most important area of cooperation in machine building is joint action to hasten comprehensive mechanization and automation of production in CEMA nations. A constant increase in the production of necessary equipment will be provided.

Thus, in this area, a general agreement is being realized for multilateral cooperation in the development and organization of specialized and cooperative production of industrial robots and a general agreement on cooperation in the development and extensive use of microprocessor technology. Under the first agreement, there have been worked out concepts for the technical development of robotics and combined products list of industrial robots and their components including 165 types of industrial robots, 89 of which are already being produced, 23 designed and 53 in the process of being designed. Under the second agreement, experimental models of prototypes for lathes and disc grinders with NC microprocessor systems have been built.

Research is being conducted to improve the technological level and quality of 142 different machine tools. This number amounts to 28 percent of all models jointly supplied during the current five-year period. In accordance with their assigned responsibilities, organizations and plants in the USSR are modernizing 57 machine models out of the 157 made for export.

One of the main features of the present stage CEMA cooperation in machine building has been a switch from organizing cooperation on the basis of comprehensively solving problems of scientific research and design work in creating a new technology to organizing specialized and cooperative production and mutual trade as well as a switch from designing individual types to creating entire systems of machinery and equipment using unified aggregates, units and parts that can comprehensively solve the problems of the different industries.

One of the most important forms of multilateral scientific, technical and economic cooperation is joint work in high-priority areas of science and technology.

Directions For Joint Work

Agreements are being realized for scientific and technical cooperation, specialization and cooperative production of basic equipment for the mechanization of loading, transport and storage work. Here, the production of 19 types of heavy-duty equipment comprising 320 different appellations has now come under a program for specialization. A product list has been developed for the most important machine and equipment units for the mechanization and automation of machine building.

In the area of sets of machinery and equipment for open-pit mining, excavation work and the building of pipelines, draft has been prepared for an agreement on multilateral international cooperation in the production of heavy-duty dump trucks with specialization involving 13 appellations of aggregates and units. Their basic technical and economic indicators have been established along with

preliminary production quotas and delivery schedules. A new 500-hp tractor is being developed. In the USSR, models of powerful new bulldozers and pipe-layers are being designed on the basis of these tractors and tested. The German Democratic Republic, USSR and Czechoslovakia are organizing the cooperative production of rotary complexes with an output of 630 cubic meters per hour and more.

In the production of machines and equipment that make more efficient and economical use of fuel and power, nearly all types types of power-generating equipment such as nuclear-power generating equipment are coming under specialized production agreements. New high-output 220- to 1000-MW automated generating equipment is being developed along with equipment for intracycle coal gasification within 1000-MW steam and gas power generating plants. Equipment has been created that makes better use of secondary power resources.

Work is being conducted on the creation of new designs for NC tools, tool-working centers, precision tools of various type, press-forging machines and other such items.

In the production of articles used in general machine building such as hydraulic and pneumatic drive systems, there have been worked out new ideas for creating single unified hydraulic cylinders, motors and miniaturized apparatus and pneumatic equipment for automation technology such as NC tools and industrial robots. The realization of these ideas will make it possible to increase the reliability of hydraulic and pneumatic systems by 30 percent, reduce the metal content of hydraulic drives by 40 percent and that of pneumatic drives by 30 percent and reduce their rate of power consumption by 20 and 25 percent respectively.

In the production of machinery and equipment for comprehensive mechanization of agricultural and livestock work, cooperation now covers 265 appellations of tractors and agricultural machines, 115 of which are new and modernized items. There has also been created about 70 new promising new technical devices. In the CEMA nations, the production of more than 600 appellations of machines and equipment for efficient processing of agriculture raw materials has been specialized. About 80 appellations of machines and equipment for the food industry have been developed.

Good results have been achieved in cooperation between international groups of scientists and specialists. In this regard, the work of a joint Soviet-Czech technological design bureau has been valuable. This organization formed the basis for the recently created "Robot" International Scientific-Technical Association.

As a result of the successes achieved in different high-priority directions, the production and mutual deliveries of machine tools has increased the actual amount of advanced machinery and equipment being produced.

Considering the particularly urgent need for hastening scientific and technical progress as much as possible, the participants to the Economic

Meeting of CEMA Nations agreed to use their national programs to develop a comprehensive program for scientific and technical progress over the next 15-20 years and use this as a basis for realizing an agreed-upon and in some cases even a single scientific and technical policy.

The CEMA Committee On Machine Building

In order to realize the tasks set by the 34th CEMA Conference in October 1984, the decision was made to establish a committee on cooperation in the field of machine building. The activities of this body were supposed to encourage more efficient design of machine-toll complexes in each of the fraternal nations, general cooperation and to hasten the introduction of scientific and technical innovations.

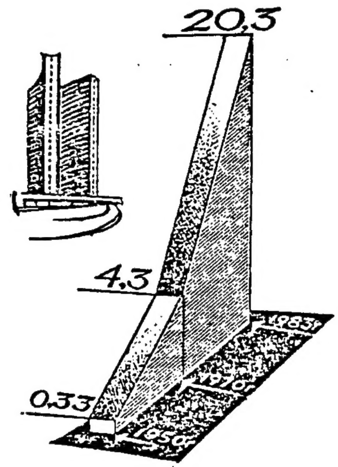
The committee and its permanent working organs pay special attention to the problems of creating and organizing specialized and cooperative production of the newest machine tools such as flexible manufacturing systems, microprocessor-based design automation technology, construction of aggregate-module programmable automated manipulators used in various industries, automated mining equipment for underground work, a set of compressed air equipment using motor fuel and equipment for waste-free reprocessing of rationed materials.

In April 1985, a meeting of the CEMA Committee On Cooperative Machine Building was held. A draft announcing the position of the activities of the committee and its permanent working organs was agreed upon. Proposals and a list of high-priority problems were approved and the schedules were set.

The committee's plan of action for the next two years calls for development of basic directions for cooperative machine building for 1986-1990 as well as prospective programs for the development of multilateral specialization and cooperation in the production of the most important classes of machines until the year 2000.

A draft was announced and recommended for a general agreement on multilateral cooperation in the development and organization of production (cooperative) of flexible manufacturing systems for machine building. Areas of cooperation were outlined for creation of advanced resource-saving technologies and the organization of joint specialized production of unique heavy-duty machines, ground machinery, mechanizing equipment for agricultural, construction and chemistry, prospective airplanes and helicopters for civil aviation and modern items for microprocessor technology and others.

Realization of these tasks will encourage more rapid intensification of the national economy and increase the efficiency of socialized production in the USSR and the other socialist countries.



Amount of trade in machinery, equipment and transport equipment between the USSR and the other CEMA nations (billions of rubles)

12261
CSO: 1823/147

INDUSTRY PLANNING AND ECONOMICS

UDC [658.516+006.015.2]001.8

PLAN TO STANDARDIZE PRODUCTION MACHINERY OUTLINED

Moscow STANDARTY I KACHESTVO in Russian No 11, Nov 84 pp 3-7

[Article by Doctor of Technical Sciences I. P. Ksenevich, winner of the USSR State Prize, chief of the Ministry of Agricultural and Tractor Machinebuilding technical administration, and chairman of the 'General Standardization Questions' section of the Gosstandart scientific-technical council, under the heading "Standards: Technical Progress, Economy, Efficiency," subheading "Standardization and Modular Design": "Standardization At the Service of Technical Progress"]

[Text] The party has indicated two primary levers for improving production efficiency and work quality -- accelerating scientific-technical progress and improving management.

Accelerating scientific-technical progress requires higher rates of industrial output updating and broader functional opportunities for such output. Successful resolution of these tasks is possible on the basis of broad practical introduction, in the development and production of machinery and implements, of scientifically substantiated methods of unitizing, comprehensively standardizing and type-sizing progressive technological processes, the use of machine design and progressive materials.

The important significance of standardizing machine design was emphasized in the resolutions of the 26th CPSU Congress and in the subsequent 18 August 1983 CPSU Central Committee and USSR Council of Ministers Decree "On Steps to Accelerate Scientific-Technical Progress in the National Economy."

The tractor and agricultural machinebuilding branch provides an example of the positive influence of standardization on accelerating technical progress.

Resolving the tasks of the country's Food Program has necessitated the accelerated development of this branch, whose tasks are defined in the 4 April 1983 CPSU Central Committee and USSR Council of Ministers Decree "On Steps to Further Raise the Technical Level and Quality of Machinery and Equipment for Agriculture, Improving its Use and Increasing Production and Deliveries in the 1985-1990 Period." During the indicated period, the Minselkhozmash [Ministry of Tractor and Agricultural Machinebuilding] must ensure the development of designs and production of several hundred types of new and modernized highly productive equipment.

Given the broad and diverse list of equipment required, standardizing the designs of tractors, motors, agricultural machinery and their component parts has become a primary and necessary prerequisite to reducing the time involved in and cost of developing new equipment, increasing the extent to which assembly units (units, subassemblies) and the parts of which machinery is composed are series produced, using this as a basis for broadening production specialization, consolidation and concentration, improving product quality and reliability, reducing the number of spare parts, and improving equipment service conditions in the area of operation and repair.

Work being done on standardization in the branch is not limited to standardizing machinery designs; extensive use is made of standardization in the areas of production technology, scientific research and experimental design organization, calculation methods, and the development of ASU [automated control systems], ASU TP [ASU for technological processes] and SAPR [automated design systems].

Diagram 1 gives a classification of the basic branch standardization work.

Diagram 1.

Key:

1. Area of standardization
2. Line of standardization
3. Target of standardization
4. International (within ISO)
5. Regional (within CEMA)
6. Interbranch
7. Branch
8. Plant
9. Design
10. Technological (processes, tooling, tools, and so on)
11. Normative (standards, calculations, specifications, and so forth)
12. Organizational (development procedures, testing procedures, production layout)
13. Machines
14. Units, subassemblies, parts
15. Structural elements of parts
16. Materials for parts
17. Technical requirements

The rise in the level of product standardization results from a broad complex of organizational-technical measures being carried out in the branch. These include:

specializing design organizations to develop specific types of machines, to create type-size series of units, subassemblies and parts for tractors, motors and agricultural machinery;

creating branch technological design bureaus;

developing and using branch blueprint files for unitized subassemblies and parts;

introducing unitized subassemblies and parts into the designs of modernized and new machines;

specializing, consolidating and concentrating the production of unitized subassemblies and parts;

developing and approving a program for unitizing and standardizing general-purpose unit, subassembly and parts designs for 1981-1985 and a comprehensive program of continued development of the specialization and concentration of their production up to 1990.

All branch scientific research, design and technological organizations and enterprises have been enlisted by the ministry in resolving the complex tasks of machinery standardization.

Implementation of the above-indicated measures has permitted a substantial rise in standardization indicators for tractors, motors and agricultural machinery being produced. The number of highly unitized families of machines with base models and modifications of them has risen more than two-fold from 1970 to the present. The level of unitization within the families of machines has reached 70-95 percent. General-purpose assembly unit and part noninterchangeability has been reduced to an average of 40-50 percent, and the applicability of unitized designs for these items to series-produced tractors, motors and agricultural machinery has risen as follows during the indicated period: based on products list type-sizes, from 684 to more than 2,100; based on total output volume, from 364 million units to nearly 900 million units. The number of narrowly specialized plants producing unitized subassemblies and parts has increased from 61 to 86.

The basic directions and organizational forms of standardization work involving tractors, motor and agricultural machinery which have been adopted in the branch are based on a systems approach and methodologically substantiated recommendations. They stem from a structural analysis of the designs of equipment being produced, which show that some component parts are used only in individual types or groups of machines, while others are common to machines of various types and groups.

In accordance with this, the branch has adopted and is following two main lines of unitization:

standard (intragroup), through the development and release of highly unitized families of monotypical machines with base models and modifications;

intertype (intergroup), through the use of unitized units, subassemblies and parts in machines of different types.

Organization and scientific-methods leadership of standardization are being exercised by the ministry technical administration and lead scientific-technical centers such as the NATI NPO ["State All-Union Scientific Research Institute of Tractors" Scientific-Production Association], for tractor building, and the VISKHOM NPO ["All-Union Scientific Research Institute of Agricultural Machinery" NPO], for agricultural machinebuilding, they also being the lead organizations for standardization.

The organizational-technical basis of machinery design standardization is the "System of Machines to Comprehensively Mechanize Agricultural Production in 1981-1985," which contains a list of current and new equipment and its basic specifications, the Minselkhozmash [Ministry of Agricultural and Tractor Machinebuilding] five-year annual standardization plans, and the programs for standardizing and unitizing standard units, subassemblies and parts of machinery.

The organizational and methods aspects of standardization are fully covered by a complex of state and branch normative-technical documents (GOST 15.001-73, GOST 23945-80, RD 50-33-80, RD 50-170-79, RD 50-173-80, OST 23.1.449-77, OST 23.2.461-77 and others). The basic branch document is OST 23.2.430-81, "Items of the Tractor and Agricultural Machinebuilding Branch. Methods and Procedures of Product Standardization Work."

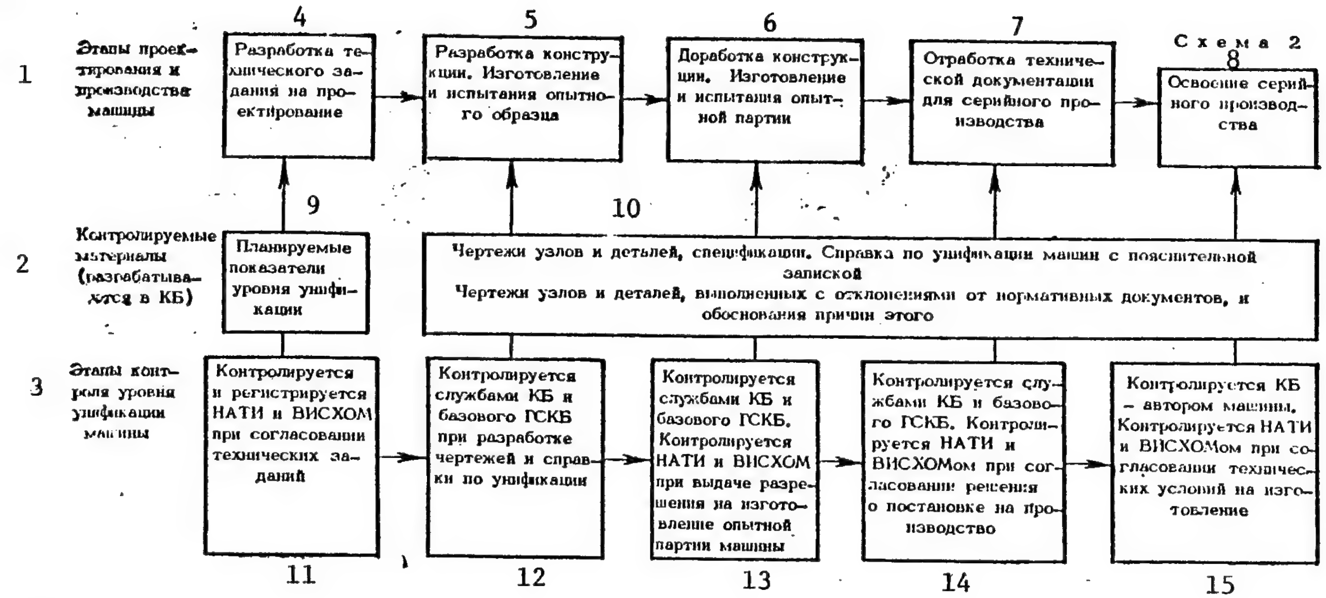
Branch product standardization is tracked at all stages of machinery development and production (Diagram 2, page following). The lead NATI and VISKHOM institutes provide expert evaluations of the level of unitization and standardization of new developments. Thus, the VISKHOM has, since 1970, evaluated and certified more than 1,200 different pieces of agricultural machinery and equipment developed by branch design bureaus.

Thanks to this system, the branch has developed and is producing a large number of highly-unitized tractors, motors and agricultural machines with base models and modifications. Such families general combine tractors of one horsepower class, motors of that or a close size, and agricultural machines of that or a close purpose.

Machine families are characterized by a high interplan (reciprocal) unitization factor $K_{m.u.}$, and each of the models comprising the family is characterized by a high applicability factor value K_{pr} (determined using the methods in State Standard RD 50-33-80 and OST 23.2.430-81).

The 1.4 tractive-class family of multipurpose wheeled plowing tractors produced by the Minsk Tractor Plant (MTZ-80, MTZ-82, MTZ-82N, MTZ-82K and MTZ-82R, $K_{m.u.}$ = 82 percent), the general-purpose 3 tractive-class tractors produced by the Kharkov Tractor Plant (T-150, T-150K, T-155, T-158, $K_{m.u.}$ = 88 percent), the general-purpose plows produced by the Odessa Plant imeni October Revolution (PLN -3-35, PLN-4-35, PLN-5-35, PLN-4, PLN-4-40, PTK-9-35, $K_{m.u.}$ = 69 percent), the plowing cultivators produced by the Krasnyy Aksay Plant (KRN-4.2A, KRN-5.6, KOR-4.2 and others, $K_{m.u.}$ = 58 percent), the grain drills produced by the Krasnaya Zvezda, Belinskselmash and Sibselmash plants (SZ-3.6, SZU-3.6, SZA-3.6 and others, $K_{m.u.}$ = 92 percent), the grain-harvesting combines produced by the Rostselmash Plant and the Taganrog and Krasnoyarsk combine plants (SK-5 Niva, SK-6P Kolos and SKD-6 Sibiryak with modifications, $K_{m.u.}$ = 68 percent) and other families are well-known.

Diagram 2.



Key:

1. Stages of machine design and production
2. Materials being monitored (developed in design bureaus)
3. Stages of monitoring the level of machine unitization
4. Development of technical assignment for planning
5. Design development. Prototype manufacture and testing
6. Additional development and design. Prototype lot manufacture and testing
7. Workup of technical documentation for series production
8. Mastering series production
9. Planning indicators of unitization level
10. Subassembly and parts drawings, specifications. Machine standardization report with explanatory note.

    Drawings for subassemblies and parts with deviations from normative documents, and justification of the reasons for them.
11. Monitored and recorded by NATI and VISKHOM for conformance to technical assignments
12. Monitored by design bureau services and the base GSKB [state special design bureau] during development of blueprints and standardization reports
13. Monitored by design bureau services and base GSKB. Monitored by NATI and VISKHOM for permission to manufacture an experimental lot of the machines

Key (to Diagram 2, continued):

14. Monitored by design bureau services and base GSKB. Monitored by NATI and VISKHOM for conformance to layout decisions
15. Monitored by the design bureau of the developer of the machine. Monitored by NATI and VISKHOM for conformance to manufacturing technical conditions.

New families of highly productive machines are also created as the principle of modular design comes into widespread use: the powerful MTZ-100 and MTZ-142 tractors (Minsk Tractor Plant), the Don grain-harvester combine (Rostselmash production association [PO]), wide-cut hitchless low-erosion cultivators and moldboardless plows (Tselinogradselmash PO), small drawn and mounted sprayers (Lvovselmash PO) and others.

The development of intertype (intergroup) unitization through the use of unitized general-purpose units, subassemblies and parts in machines of different types is a most complex task, due to the significant range of types of machine designs, the large number of design organizations and enterprises developing and producing equipment, and the frequent lack of specialized production and centralized delivery of general-purpose items to machine manufacturing plants.

In view of this, a system of projects to introduce unitized units, subassemblies and parts into the designs of new machines and ones already in production has been developed and is being implemented to successfully follow the line of intertype standardization in the branch.

It is based on the development and introduction of branch standards and files of blueprints of standardized designs for standard general-purpose subassemblies and parts. These operate at the same level as the standards and are circulated among or sent out to all branch design bureaus and plants, and they ensure the use and manufacture of unitized subassemblies and parts for different manufacturing plants using common blueprints and having common designations.

The branch currently has more than 150 such design files (RTM-A) covering practically all groups of standard subassemblies and parts widely used in tractors, motors and agricultural machinery.

The creation of RTM-A files has resulted in a substantial reduction in the number of different types of parts and the number of standardized facilities. Thus, whereas 112 type-sizes of bevel reduction gears were previously used in series-produced agricultural machinery, after they were typified and standardized, only 22 type-sizes were included in the reduction-gear RTM-A for mandatory use.

The standardization services of design organizations and the lead NATI and VISKHOM institutes, offering expert appraisals of design documentation for new machines in accordance with GOST 15.001-73, monitor the obligatory use of unitized subassemblies and parts in accordance with the RTM-A when new machines are being developed.

The centralized recording of the applicability of unitized subassemblies and parts under RTM-A in series-produced machines which is done by the NATI and VISKHOM is an important link in the system. In this regard, summary materials are published periodically (every two years) and sent to all organizations and enterprises, as well as to ministry production subdivisions. This enables us to:

reveal the status of the introduction of unitized subassemblies and parts by products list and in terms of production volume;

inform design bureaus and plants of the branch about unitized items already introduced, so they can be given preference when designing new machines;

reveal specific subassembly and parts brands which are being manufactured simultaneously at several plants, in order that steps can be taken to consolidate, concentrate and specialize their production.

Branch implementation of the indicated system for developing and introducing RTM-A files has enabled us to achieve definite positive results. The applicability of unitized RTM-A items in machinery in production has increased severalfold (Table 1).

Table 1.

	1970	1975	1980	1985	1990
List of items (type-sizes) being used, by year	684	1,329	2,054	2,300	2,600
production volume, unitized items, millions of units	364.0	625.6	814.4	900	1,600
number of RTM-A files of unitized items	89	125	137	152	175
number of different series-produced machines using unitized RTM-A items	120	175	270	300	600

Many unitized subassemblies and units with the same name are now being used in very different machines. Thus, the two-plate A 52.20.000 disk for RTM-A 23.1.52-82 is used in 15 brands of tractors simultaneously (T-74, TST-55, DT--75A and others), as well as in the self-propelled Niva, Kolos and Sibiryak grain combines; the first-stage A 23.10.000 fuel filter for RTM-A 23.1.23-80 is used in 16 brands of engine simultaneously, and so forth.

All wheeled tractors in traction classes 0.6 to 3.0 (25 brands) use only three type-sizes of steering rods; 21 models of tractors in the 0.6 to 1.4 class use only two type-sizes of brakes; thanks to standardization, the products list of accessories for servicing tractors and agricultural machinery has been reduced from 42 to 11 type-sizes. All tractors and agricultural machinery being produced use a products list of hydraulic units -- pumps, distributors, hydraulic cylinders -- which has been reduced to a minimum.

Steps are also being taken to reduce the noninterchangeability of assembly components for interbranch application. Restricting lists and standards have been developed and introduced into practice for the use of automotive and tractor electrical equipment and instruments, electrical equipment, bearings, V-belts, pneumatic tires, and so on.

Expanded parts, subassembly and unit production specialization provides continuous growth in the production volumes of unitized items at specialized plants and an increase in the proportion of these items in the overall production volume for agricultural equipment (Table 2).

Table 2.	1970	1975	1980	1985
number of specialized plants, by year	61	76	84	86
proportion of unitized items in overall production volume, in percent	24.3	26.3	26.8	28.6
number of groups of unitized items switched over to specialized production	1,235	1,972	2,682	3,670

Specialized plants also produce such widely used items as piston rings, crankshafts, filters, fuel pumps, pistons, hydraulic units, universal joints, reduction gears, cutting units, grills, and much more. Production of these items is concentrated basically at enterprises of the Soyuztraktorodetal and Soyuzselkhozmashgidroagregat VPO's and at other all-union industrial associations.

The ministry has approved and is implementing a "Comprehensive Program of Further Development of Specializing and Concentrating the Production of Units, Subassemblies and Parts, As Well As Blanks (Castings, Die Forgings) Up To 1990" which, along with assignments on developing and introducing standards and RTM-A for widely used unitized items, also establishes specific assignments on developing existing and creating new specialized plants, shops and sectors.

A systems approach to resolving the tasks of unitizing the designs of tractors, motors, agricultural machinery and their component parts, the complex of organizational-technical measures carried out in recent five-year plans along this line, and the overall increased attention to standardization problems on the part of the ministry and its scientific research institutes, design organizations and enterprises have, as was demonstrated above, enabled us to achieve appreciable branch results in raising the level of standardization of equipment being produced and developed.

At the same time, there are still substantial shortcomings and unresolved questions in standardizing machines and components being produced.

For example, inadequate use is being made of reserves for standardization among tractors of the exact same or related traction classes which are produced by different plants (wheeled tractors of the Minsk and Lipetsk tractor plants, caterpillar plowing class-3 tractors of the Volgograd and Altay tractor plants, and others).

We are not using all opportunities to standardize motors, drive systems, cabs and other common elements in the designs of various self-propelled combines -- grain harvesters, corn harvesters, potato harvesters, beet harvesters, and so on.

The modular principle of laying out machines using unitized sections, blocks and units is still not being fully used in the development of new agricultural machinery.

Along with the unitized assembly units and parts established by the standards and RTM-A files, machines also use a significant number of analogous original designs. One reason is the inadequate number of specialized production facilities. The production of a number of unitized general-purpose items is still scattered among machinery manufacturing plants (hydraulic fittings, bearing subassemblies, sprockets, and others).

With a view towards eliminating these shortcomings and further raising the level of standardization of items in production, the ministry is taking necessary steps.

Work on applying the modular principle to create new machines is being broadened. This principle consists basically in developing new families of highly productive wide-cut cultivators, moldboardless plows and other low-erosion equipment, grain and beet drills, attachments for applying mineral fertilizers and chemical means of plant protection, and other agricultural machinery and equipment.

By 1990, all models of tractors in production (agricultural, industrial, logging) and all the basic types of agricultural machinery will be highly unitized machines. Unitization among self-propelled harvesting combines of different types will be significantly increased as a result of the development and introduction of unitized drive and steering axles, hydraulic and mechanical transmissions, cabs and controls.

We plan to develop and introduce a broad range of new unitized hydraulic units designed for operation at high pressures, as well as unitized devices, instruments and other means of automating machinery-tractor units.

Priority attention is being focused on raising the technical level and improving the quality and reliability of unitized units, subassemblies and general-purpose parts through the use of progressive design and technological resolutions of the leading foreign companies producing similar items. Steps are being taken to strengthen the experimental base of OKTB's and SKTB's [experimental and special technological design bureaus] specialized to develop general-purpose items.

Machine and component interbranch unitization work will be expanded.

A program is being developed for unitizing widely used general-purpose items and specializing their production up to 2000. We intend to concentrate the production of all standard subassemblies, units and mass-produced parts basically at specialized plants so as to thus meet the requirements of all tractor, motor and agricultural machinery manufacturing plants for these items.

For the 12th Five-Year Plan as a whole, the level of unitization of machinery and components being produced in the branch will be raised to technically and economically substantiated optimum values.

Interbranch standardization difficulties arise for a number of objective and subjective reasons. These relate first of all to the fact that designers make insufficient use of subassemblies and units already developed when designing new equipment. We know, for example, of the unjustified noninterchangeability of analogous units and subassemblies used in automobiles, tractors, combines,

roadbuilding, construction and other self-propelled machinery (motors, transmissions, drive train parts, brake systems, hydraulic units, cab equipment and so on). This situation does much to reduce the economic impact of the use of these machines in the national economy.

The path to successfully solving this problem encounters questions of creating an economic mechanism which will stimulate the interest of design organizations in increasing machinery unitization through borrowed subassembly and unit designs, by organizing specialized production, and so forth.

The attempt to borrow designs from other design bureaus is currently running into the entrenched practice of long, complicated concurrence, which objectively forces one to reject "others'" designs and to develop one's own, which can thus be protected with an author's certification, with all the material incentives stemming from that. This decision can be encouraged if a new design of an analogous subassembly turns out to be better than one already developed in terms of its technical level, but this always leads to longer development times for machinery and to other negative consequences.

For their part, the tracing-paper design organizations are not interested in transmitting their designs to others. In individual instances, this lack of interest is a consequence of the prospect that transfer of such documentation will be followed by a demand to deliver items on a cooperative basis, for which the plants may not be prepared and may not be supported in developing (creating) the capacities to do so by the corresponding departments.

The mixing of two different concepts -- borrowing the design for a subassembly or unit and delivering finished assembly components -- requires that strict rules be established. The right to use assembly components without coordinating them with the producer is given only to general designers designated by the USSR Council of Ministers and does not eliminate substantial problems for all the remaining design organizations.

The interests of machinebuilding and, in the end, of the national economy dictate the necessity of accelerating resolution of the problems of interbranch production unitization and specialization.[1]

To this end, it seems appropriate to carry out the following additional measures:

1. Institute material incentives for organizations developing new equipment for achieving a prescribed technical level and level of unitization (interbranch and branch), including through borrowing designs and elements of designs from machines developed by other organizations. The source of such incentives could be a surcharge to the wholesale price for effectiveness in accordance with statutes in effect for setting such prices. Establish a procedure for deductions to the

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[1]An important role in resolving this question is given to GOST 26198-84 "Interbranch Standardization. Work Procedures," GOST 26199-84 "Branch Standardization. Work Procedures," GOST 26197-84 "Program of Standardizing and Specializing Machinebuilding Production. Development Procedures," and GOST 26200-84 "Plant Standardization. Work Procedures."

economic incentives fund (FES) of developers whose designs are used in a machine being created. In the general case, the deducted portion of the FES must be proportional to that percentage of the cost of the borrowed units in the overall cost of the new machine. A line diagram of the proposed incentive mechanism is given in Diagram 3.

Diagram 3.

development of a new machine

borrowed units, subassemblies, parts

machine already developed and in production (from other design bureaus and plants

economic impact on the national economy of introduction of the new machine

deducting a share of the surcharge to the material incentive fund for use of borrowed units and subassemblies

price surcharge for effectiveness (or for Badge of Quality)

developers' material incentive fund

including

material incentive fund under existing statute + fund addition for high degree of unitization and for borrowing

2. With a view towards practical implementation of the proposed economic incentives mechanism for attaining high indicators of interbranch and branch machine unitization, it is necessary to make corresponding refinements in and supplements to the "Regulations on Procedures for Forming and Using Economic Incentives Funds in Scientific Research, Design, Planning-Design and Technological Organizations...," which were approved by the State Committee for Science and Technology, USSR Gosplan, State Committee for Labor and Social Questions, USSR Ministry of Finance and AUCCTU on 10 April 1980, as well as to supplement No 1 to the "Methods for Setting Wholesale Prices and Net Output Normatives for New Machinery, Equipment and Production-Technical Instruments," approved by the State Price Committee on 18 December 1983.

3. Develop a state standard regulating procedures for drawing up a borrowed design for use in other machines; make expert evaluations of the level of item unitization in accordance with GOST 15.001-73 so as to reveal the most important borrowed units, subassemblies and parts and to determine their share of the new item; track the use of borrowed designs and deductions by developer enterprises of that portion of the profit obtained from price surcharges for the effectiveness of the new equipment to FES.

4. Review current branch standards for general machinebuilding items and rescind them if they deviate from state standards.

5. Develop regulations on creating and operating a reference databank for domestic machinebuilding subassemblies, parts and units.

Implementation of these measures will accelerate carrying out the tasks contained in the CPSU Central Committee and USSR Council of Ministers Decree "On Steps to Accelerate Scientific-Technical Progress in the National Economy."

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INDUSTRY PLANNING AND ECONOMICS

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IMPROVEMENT OF DESIGN, PROCUREMENT PHASE CONSIDERED

Moscow STANDARTY I KACHESTVO in Russian No 3, Mar 85 pp 28-30

[Article by Candidate of Technical sciences V. L. Mikhel'son-Tkach, docent at the Bryansk "Order of the Badge of Honor" Institute of Transport Machinebuilding, under the heading "Experience in Developing and Introducing Standards": "Questions of Developing and Introducing Technological Suitability Control System for Machinebuilding Product Designs"]

[Text] The qualitative evaluation of the technological effectiveness of product design (TKI) which is regulated by the YeSTPP [not further identified] standards establishes that they have attained certain values and creates prerequisites for the development and introduction of a control system for this process.

The stating of definite TKI requirements, meeting them when designing and manufacturing a product and evaluating the level attained at various stages of plan implementation are nothing more than stages in managing design technological effectiveness. It is known that any management process includes certain component elements such as planning, recording, monitoring and regulation.

Planning design technological effectiveness levels begins in the stage of client requests for developing and mastering the production of an item (1), an inseparable part of which is the initial requirements of the customer, including operating conditions and installation technological effectiveness requirements, if the product is to be installed by the consumer, as well as information on analogous items, both foreign and domestic, whose functional purpose is identical.

Thus, the foundations for controlling the technological effectiveness of an item are laid in the pre-planning stage.

But the TKI management system would be unthinkable without a precise, unambiguously defined statement of the rights and obligations of all participants in the process of developing new products, without a regulation mechanism based on recording and monitoring.

Experience in joint work by our institute with the special planning-design and technology bureau of chemical and petroleum machinebuilding (SKTBkhimmash) in developing and introducing a design technological effectiveness control system

in the Ministry of Chemical and Petroleum Machinebuilding has demonstrated that this system anticipates implementing a number of organizational, methods and technical measures, the most important of which are:

precise delimitation of TKI functions, both by level of management and by implementer, and including definition of their interconnections and accountability;

selection of the list of TKI indicators;

deciding questions of the methodology for choosing base items and designating the base indicators of design technological effectiveness and the maximum allowable deviation from them;

development of normative-technical documents regarding qualitative final development of items for technological effectiveness.

Let us examine the bases for such an assertion.

The TKI problem, as it is at the intersection of the activities of design and technological subdivisions, constantly causes disputes and discussions about who should be responsible for solving it. Workers in these subdivisions do not deny the importance and urgency of the problem, but each attempts to shift responsibility for solving it to the other. Thus, 87.2 percent of the designers surveyed maintained that technologists must be responsible for design final development for technological effectiveness, while 77.8 percent of the technologists would shift responsibility to the design services.

The branch NTD's [normative-technical documents] must stipulate precisely which service is to perform particular final work on items for technological effectiveness and at what stage, as well as the functions of the various levels of management concerning this work.

The "Regulations on the Branch Product Design Technological Effectiveness Management System" (RDP 26-57-82) developed jointly by our institute and the SKTB-khimmash and introduced in the Ministry of Chemical and Petroleum Machinebuilding in 1982 provide precise answers to these questions.

They establish that design organizations will:

1. work out normative-technical documents which determine the numerical values of the base indicators of design technological effectiveness for the products list of items assigned to them.

2. do final item design work for technological effectiveness at all stages of planning.

3. make qualitative and quantitative evaluations of design technological effectiveness at all planning stages.

4. calculate the level of technological-effectiveness indicators actually achieved and the level of design technological effectiveness.

5. make changes in designer documentation, based on prototype production results, which ensure improved item design technological effectiveness.

Technological organizations will:

1. participate in developing normative-technical documents determining the numerical values of the base indicators of item design technological effectiveness

by products list assigned it (as concerns designating the numerical values of the description of the level of technology for manufacturing the items).

2. develop normative-technical documents defining qualitative evaluation of the technological effectiveness of item design by manufacturing process assigned the organization and by type of item being manufactured by enterprises assigned it.

3. provide expert technological evaluations of designer documentation for the most important items which is submitted by design organizations and analyze the technological effectiveness of the designs of these items, including with these appraisals records and conclusions.

4. make proposals on changes in designer documentation stemming from the demand that the technological effectiveness of the design of an item being manufactored be ensured; these are to be made to the designer organizations based on production results at manufacturing enterprises.

5. work out and submit to an all-union industrial association for review proposals on organizing specialized subdivisions at the enterprises for centralized manufacture of standardized and unitized parts and assembly units for use in the branch or a subbranch.

The regulations establish that production, scientific-production associations and enterprises will:

1. provide input monitoring of designer documentation for conformance to the corresponding requirements in terms of qualitative and quantitative evaluations of the technological effectiveness of item design and draw conclusions as to the level of technological effectiveness of item designs.

2. work out proposals on improving the technological effectiveness of item design, for transmittal to the design organization.

3. calculate technological effectiveness indicators actually achieved for items being manufactured, based on the list of indicators established for the item.

4. make proposals to technological organizations on creating specialized subdivisions for the centralized production of standard and unitized parts and assembly units.

This same regulation establishes the obligations of the VPO's and the ministry Technical Administration in the area of ensuring design technological effectiveness. At the branch leadership level, the functions of organizing and monitoring item design final development for technological effectiveness are performed by the Technical Administration of the ministry and are, in brief, to

1. organize the development and resolution of scientific-technical problems in the area of TKI, to ensure their actualization at ministry enterprises and organizations.

2. exercise long-range planning and coordination of all work in the area of ensuring item design technological effectiveness in the branch.

3. lead the development of normative-technical documents ensuring the qualitative and quantitative evaluation and final development of item design technological effectiveness.

4. ensure, through the all-union industrial associations and lead organizations, the introduction of normative-technical documents for the design technological effectiveness management system.

5. organize scientific and scientific-technical information on the problem of ensuring the technological effectiveness of item design (proparing and publishing, following established procedures, normative-technical documentations and elaborated files of standard technical resolutions), to widely propagandize leading scientific-technical experience in this area.

6. make decisions involving differences of opinion between organizations and enterprises of various subbranches in the area of ensuring item design technological effectiveness.

The all-union industrial associations are to:

1. organize the development of and approve normative-technical documents establishing the numerical values of the base indicators of technological effectiveness.

2. set up the monitoring of design technological effectiveness level achieved for the most important products list.

3. take steps to ensure unconditional attainment of the planned level of design technological effectiveness for items assigned the subbranch.

4. make decisions involving differences of opinion in the area of ensuring technological effectiveness among enterprises and organizations of the subbranch.

5. organize work on standardizing parts and assembly units for subbranch application.

6. organize specialized enterprise production subdivisions to centralize the manufacture of unitized parts and assembly units for subbranch application.

Such unambiguous definitions of the obligations and responsibilities of all industry organizations and subdivisions engaged in the development and introduction of new items into production enables us to set up proper procedures for work on solving the problem of item design technological effectiveness.

In our opinion, in order to achieve unconditional implementation of the complex of work to finish item designs for technological effectiveness, all machine-building branches must develop and approve branch NTD's defining this work.

A second very important question in creating the system of technological effectiveness management is selection of the list of TKI indicators used to evaluate item design technological effectiveness.

Without examining this question in detail, let us note that all TKI indicators can be clearly separated into two groups, to wit: indicators directly describing resources expenditures on producing an item (technological labor intensiveness, materials- and capital-intensiveness of manufacture) and indicators describing methods of lowering resources expenditures (unitization, standardization, modularization, and so forth).

Enterprise and organization work experience testifies to the fact that it is appropriate to use as indicators of technological effectiveness the indicators of the first group, as well as indicators of unitization and the use of standard technological processes which are the directive indicators for branches, VPO's and enterprises. The total number of such indicators must be comparatively small (five or six).

Equally important when creating the TKI management system is the question of methods of designating the numerical values of the base TKI indicators and determining the implementers of this work.

Determining base indicators is the initial stage in final development of item design for technological effectiveness. In fact, if base indicators have, for some reason, not been established for a given item, one cannot objectively evaluate the technological effectiveness of a design, since there is no benchmark value to strive for. The methods of resolving this question are presented quite fully in (2). It is important to note that a general technical assignment for developing branch documents operates within the framework of developing and creating a system of design technological effectiveness management in the Ministry of Chemical and Petroleum Machinebuilding. Called the "Base Indicators of Item Design Technological Effectiveness," it was developed by our institute and has been approved by the Ministry of Chemical and Petroleum Machinebuilding Technical Administration.

As was noted above, the lead design organizations for the particular items have been entrusted with developing the NTD's being reviewed in the branch. This decision is supported by the fact that it is these very organizations in which the documents carrying information on the analog-item technological effectiveness indicator values achieved are concentrated (analog meaning of identical functional purpose), both for items produced in our country and for those produced abroad (technical level and quality charts, enterprise and organization reports on item technological labor intensiveness, and so forth).

At the same time, the lead design organizations might not have available to them precise information (as, for example, information on the values actually achieved for availability of component parts for standard technological processes, the directive values for these factors, and so forth), so they must be given the right, in the NTD development stage, to request and receive information from enterprises and technological institutes on the values of technological effectiveness indicators actually achieved for items produced by these enterprises.

The draft of a corresponding normative-technical document specifying the values of the base indicators of item design technological effectiveness must be agreed to by the lead technological organization to which the particular item is assigned, since it is this organization which has information on the actual and directive values of the level of the technology being used.

One very important element in the system of design technological effectiveness management is the development and issuance of normative technical documents in which technological effectiveness requirements are presented in terms of item manufacturing processes; these are for use by designer organizations.

In the general case, when planning parts, assembly units and items, the designer encounters the necessity of selecting from among a number of possible technically-equivalent resolutions one which is most economical. In resolving the task, the question of how much the variants differ from each other quantitatively does not arise; it is important to choose that variant which is easier to manufacture, which does not require unnecessary expenditures of all resources, in other words, that which is most technologically effective.

The task must be resolved using qualitative criteria by evaluating their conformance to the demands of the manufacturing processes. And "manufacturing process" is understood to mean type of production or type of work, for example: casting process, pressure-working, cutting, and so forth.

In making this analysis, it is naturally important what the practical experience of the designer is, his knowledge of possible methods of processing and assembly, the demands made on the design by these manufacturing processes. But the personal experience of the workers in design subdivisions differs, and to rely on it means to ignore leading collective experience, to embark on a subjective path. There is no doubt about the fact that the designer cannot, due to the specifics of his own theoretical training and practical experience, possess, as a rule, deep knowledge of absolutely all the technological requirements and manufacturing processes which are possible. Engineering services specialization inescapably leads to a situation in which even technologists working in the field of developing technological processes cannot be competent in all types of processes. Thus, a technologist specializaing in cold-cutting metals often does not know the intricacies of the technological requirements of welding, casting, forging, and so forth.

The conclusion can be drawn from this that the technological requirements of particular manufacturing processes can and must be formulated by technologists specializing in these processes and must be set down in the corresponding normative-technical documentation. Documents reflecting advanced scientific and technical experience should be reviewed periodically and refined to reflect theoretical developments and accumulated experience, but at any given moment, they must reflect precisely and unambiguously the technological requirements of specific manufacturing processes or types of necessary work. In using such normative-technical documents, the designer can, when working up a particular variant of a technical resolution, establish whether or not they correspond to the technological requirements of the corresponding manufacturing processes. This work both can and must be done constantly as the designer examines variants, since it is precisely such analysis which enables one to eliminate from further development variants which do not correspond to the technological requirements, that is, those which are technologically less effective.

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REASONS FOR SHORTAGE OF NC MACHINISTS DISCUSSED

Moscow IZVESTIYA in Russian 22 Mar 85 p 3

[Article by N. Zykanov, chief of the Orel Oblast Administration for Vocational and Technical Education: "Lessons for Tomorrow"]

[Text] It is well known that computers and microprocessors have now become a part of the equipment of enterprises and institutions in most ministries and departments. The new electronic devices are being put into practical operation particularly rapidly in the machine building, machine tool and instrument making industries, communications and the statistical service.

Orel is one of the territorial centers of the country for the introduction of robots into production. It includes five leading instrument making associations and a plant for machine graphics equipment. The Prompribor production association has been a base enterprise for introducing automated equipment. Here the first testing facility for robots in our oblast was created, where specialists conduct the assembly, adjustment and running-in of electronic helpers, that is, they teach them to do work that is monotonous, strenuous or harmful for a human being.

New technology also dictates new demands for the training of highly qualified specialists. While two or three years ago we did not turn out a single operator or adjuster for numerically controlled (NC) machine tools, now every year we recruit several groups of regulators and inspectors of electromechanical and radio engineering instruments and operators of NC machine tools and computers.

I am going to say it right out: these professions are much more attractive for young people than the traditional ones. The difficulty, however, lies in the fact that the general education school up to now has not given the students even the basics of electronic literacy. Therefore for its graduates robots, computers and microprocessors are still wrapped in a shroud of mystery. It is true that starting in the next school year, as is known, a course in the basics of computer technology will be included in the school program.

Unfortunately, the process of teaching the basics of this knowledge has not yet been put in order in our vocational and technical schools either. We do not have the necessary training materials and equipment. Let us say that we have to train a machine tool operator of the new type on machine tools that

have long been obsolete. We can explain the lay-out and operating principles of a NC machine tool, not to speak of a robot, at best only with diagrams.

The base enterprise for SPTU-9 agricultural vocational and technical school is a textile machinery plant. All the training shops are not in the school but in the plant. We are permitted to work at 18 NC machine tools. This school also has a training classroom at the Yantar' watch association, for which we train watch assemblers and inspectors of parts and electronic instruments. The school provides inspectors and regulators for the control computer plant.

How is the training and educational process set up in such conditions? Three days a week the young people study within the walls of the school and three days they spend in practical training at the plants. The unity of the theoretical and practical training of the future specialists is broken, and it is difficult to plan social and political work in groups. As a result, instead of devoting all their effort to the training and educational work of the school the administration and the instructors are forced to maneuver among three plants and adapt themselves to the requirements of three departments.

In addition, if one is to be completely frank, we have the status of poor relatives in the plant workshops. Those NC machine tools are made available to us only because they are not working up to full capacity. In other words we are making use of production irregularity. If those machine tools were to work the way they are supposed to, our students would simply be denied access to them.

In our own workshops we have the kind of "primeval" screw-cutting lathes that have not been used at industrial enterprises for a very long time.

Meanwhile, the work of the machine tool operator in our days requires completely different skills and knowledge. For example, instead of the accustomed levers and hand wheels, which we train the future lathe operators to use on our hopelessly obsolete machine tools, on the new machine tools there are buttons and a keyboard with the aid of which the necessary information is entered in the memory of the machine. Then the microprocessor takes care of operating the machine tool in the automatic mode.

Approximately the same situation exists in other schools. We are even teaching the first and to date only group on robots in Orel, which has been assembled at the SPTU-7, on the same screw-cutting lathes with their obsolete design. We asked the USSR Ministry of Ferrous Metallurgy (the base enterprise of this school is the Orel steel rolling mill) for only two or three modern machine tools - in vain. We tried to enlist the support of the Prompribor association for which, as a matter of fact, we train adjusters for robots and manipulators, but there too they replied: wait a while. And I dare say we are not the only ones in such a position.

It is not enough to recognize the importance and the indisputable advantages of the new technology. It is also necessary to take a confident step in the matter of training specialists who will measure up to the requirements of the scientific and technical revolution. The path to this goal is pointed out in

the well-known decree of the CPSU Central Committee and USSR Council of Ministers "On the Further Development of the System of Vocational and Technical Education and Raising Its Role in the Training of Skilled Working Cadres." And where the departments have approached the implementation of the obligations assigned them with a full sense of responsibility, impressive results have been achieved.

For example, the Orel SPTU-7 began training operators of calculators for the oblast statistical administration three years ago. There were 100 persons in two groups. The USSR Central Statistical Administration issued the school about two dozen of the newest calculators with displays for this specific purpose. There is no getting around the fact that the expenditures were substantial. The gains, however, were also beyond doubt! The data processing center of the oblast statistical administration had an acute need for operators of electronic calculators. Now we train operators for the data processing centers of other Orel enterprises too. And the specialists coming out of the school do not have to be re-trained at the plant.

It is apparent that this is the proper way to go in the system of relationships between base enterprises and vocational and technical schools. Obviously all ministries and departments when distributing modern equipment, materials and tools to base enterprises should issue what is specifically intended for vocational-technical schools as a separate line item. This will help to bring the training process closer to the practice of modern production, as is required by the reform of general education and vocational schools.

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INDUSTRY PLANNING AND ECONOMICS

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MACHINE TOOL UTILIZATION RATES, SERVICE LIFE SURVEYED

Moscow MASHINOSTROITEL' in Russian No 2, Feb 85 pp 34-36

[Article by Yu. V. Charukhin under the heading "To Help the Economics Student": "Equipment Shift Index in Machinebuilding"]

[Text] The shift index occupies a special place among the indicators of equipment fixed assets use, since it reflects how long it is used in the course of a day and is directly linked to the most important indicators of enterprise operation efficiency and quality.

According to the methods the Central Statistical Administration [TsSU] uses for one-time surveys, the equipment operation shift index is a generalized indicator of full-shift equipment use for multiple-shift operation and shows how much each unit of equipment produces on an average shift in a 24-hour period. It measures the ratio of the the number of machine-tool (machine) shifts worked in a 24-hour period to the total amount of equipment installed. This indicator should be used very circumspectly in evaluating enterprise operation. Without establishing growth factors for the enterprise and evaluating [their] influence on basic technical-economic indicators, one cannot judge enterprise operation. The shift index cannot be used as an indicator of production efficiency, which is defined as the ratio of useable result (impact) to expenditures causing it. It only describes the use of equipment over time.

The shift index interacts with the system of social indicators of the labor collective. This link is strengthened under modern economic development conditions. Thus, providing enterprises with the latest equipment is connected with changes in the occupational and skill structure of the workers. A number of social problems connected with transport services for shift workers, with providing them with kindergartens and day nurseries, with training in night school (VUZ's), and so on, arise in this regard. Thus, the rise in the shift index is reflected throughout the system of indicators of enterprise production-economic activity and is of important significance in intensifying production and increasing its efficiency.

Since 1963, the USSR TsSU has made one-time observations of equipment use, enabling it to trace changes in the metalworking equipment operation shift index (Table 1, following page). The shift index is recorded for all machinebuilding ministries using a single method and homogeneous equipment composition. In 1982,

Table 1

Equipment Shift Index

Indicators	1963	1965	1967	1979	1971	1973	1975	1982
In production as a whole	1.44	1.40	1.37	1.33	1.33	1.34	1.35	1.37
Including basic production	1.51	1.45	1.43	1.39	1.39	1.40	1.41	--

the production capacity use factors and equipment shift index were recorded for 11 ministries (Table 2).

Table 2.

	production capacity use factor	equipment shift index factors		
		average	maximum	minimum
(1)	0.93	1.4	1.82	0.96
(2)	0.86	1.3	1.66	0.94
(3)	0.87	1.43	2.97	0.55
(4)	0.87	1.32	1.82	0.78
(5)	0.79	1.35	2.0	0.26
(6)	0.86	1.27	1.82	0.48
(7)	0.92	1.51	2.11	0.74
(8)	0.9	1.33	2.66	0.63
(9)	0.93	1.51	1.82	0.57
(10)	0.9	1.24	2.9	0.4
(11)	0.82	1.24	2.33	0.8
(12)	0.88	1.37	--	--

Key:

1. Ministry of Automotive Industry
2. Ministry of Power Machinebuilding
3. Ministry of Electrical Equipment Industry
4. Ministry of Medical Industry
5. Ministry of Machinebuilding for Animal Husbandry and Fodder Production
6. Ministry of Machinebuilding for Light and Food Industry and Household Appliances
7. Ministry of Tractor and Agricultural Machinebuilding
8. Ministry of Chemical and Petroleum Machinebuilding
9. Ministry of Instrument Making, Automation Equipment and Control Systems
10. Ministry of Machine Tool and Tool Building Industry
11. Ministry of Heavy and Transport Machinebuilding
12. Average for all ministries

The proportion of the enterprises surveyed in which the shift index is less than one is 5.2 percent, and the proportion in which it is more than one is 1.8 - 6.3 percent. Given two-shift enterprise operation, a shift index of 1.4 - 1.6 is most typical, but the proportion of enterprises with this index is only 19.7 percent.

Surveys done by the USSR Central Statistical Administration have shown that the shift index for metal-cutting machine tools installed at enterprises rises as the scope of production increases (Table 3, following page). This is a quite natural phenomenon. Frequent changes in product, infrequent run repetition and a low level of assembly unit and parts standardization are characteristic of single-run and small series production. In such production, it is hard to take an even load on various groups of equipment into account. As the size of an enterprise increases, equipment incompleteness decreases. One must not fail to take this into account when deciding to raise the shift index at machinebuilding plants to increase production.

Table 3.

enterprises, with numbers of metal-cutting machine tools installed	number of enterprises surveyed	installed equipment, 1,000 units	equipment shift index	machine-tool hours worked per unit of installed equipment
up to 50	173	6.4	1.2	8.5
51-100	300	26.3	1.26	8.8
101-200	537	82.9	1.3	9.2
201-500	867	277.9	1.38	9.8
501-1000	512	350.1	1.4	9.9
1001-2000	241	310.4	1.41	10.1
over 1001	142	488.0	1.48	10.2
total, all enterprises surveyed	2,772	1,542	1.41	10

Type of production also influences shift index value. Thus, for example, the average shift index in single-run and small-series production among the enterprises surveyed was 1.28, while it was 1.39 in series production and 1.48 in large-series production.

A comparison of the dynamics of change in the metalworking equipment shift index as a whole is of some interest. The figures (in Table 4) are for basic and auxiliary production for 1977-1982 for various machinebuilding ministries. As is evident from the table, the actual shift index for all ministries has dropped, both for machinebuilding as a whole and in basic and in auxiliary production.

Table 4.

ministry	shift index for metalworking equipment								
	as a whole			basic production			auxiliary production		
	1977	1980	1982	1977	1980	1982	1977	1980	1982
(1)	1.3	1.3	1.24	1.36	1.38	1.32	1.12	1.10	1.19
(2)	1.4	1.34	1.3	1.48	1.44	1.38	--	1.14	1.09
(3)	1.49	1.44	1.4	1.59	1.54	1.51	1.26	1.2	1.17
(4)	---	1.26	1.24	--	1.33	1.32	--	1.08	1.05

Key:

1. Ministry of Heavy and Transport Machinebuilding
2. Ministry of Power Machinebuilding
3. Ministry of Automotive Industry
4. Ministry of Machine Tool and Tool Building Industry

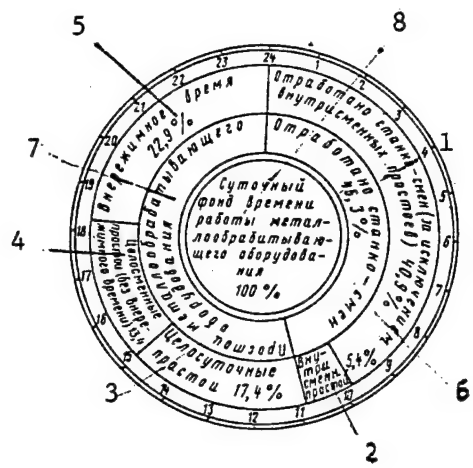
In this regard, the total amount of metalworking equipment has increased. Thus, for example, the amount of equipment in the Ministry of Power Machinebuilding increased by 15.4 percent from 1977 to 1982, and by 10.9 percent in the Ministry

of Heavy and Transport Machinebuilding. The shift index dropped for all groups of metalworking equipment in these two ministries.

Metalworking equipment is being used considerably poorer in auxiliary production, where an average of 30-35 percent of the equipment is concentrated. The shift index is approximately 20 percent lower than in basic production.

Equipment is used unevenly over the course of the work day at all the enterprises surveyed. The bulk of the equipment load is in the first shift.

The main reasons for the reduction in equipment shift index are the lack of a full complement of workers and considerable whole-day and whole-shift idle time. The diagram [clock, below] can be used to judge the proportion of whole-day and whole-shift idle time. As the analysis shows, the low equipment operation shift index at machinebuilding enterprises is connected with the installation of unnecessary or unused equipment, and especially metal-cutting equipment, with the failure to mate production capacities of related sectors, with production bottlenecks and with a lack of a full complement of worker personnel.



Key:

1. Machine tool shifts worked (excluding intrashift down time) 40.9 percent
2. Intrashift down time, 5.4 percent
3. Whole-day down time, 17.4 percent
4. Whole-shift down time (excluding nonscheduled operating time) 13.4 percent
5. Nonscheduled operating time, 22.9 percent
6. Machine tool shifts worked, 46.3 percent
7. Metalworking equipment down time
8. Daily metalworking equipment total operating time available, 100 percent

According to data from a one-time, day-long study run by the USSR Central Statistical Administration on 15 May 1980, at enterprises of the machinebuilding industries, 22.9 percent of the installed equipment was not operated in any of the shifts, and the equipment which was operated ran for an average of 10.1 hrs. In this regard, it was used extremely unevenly over the course of the day: 82 percent in the first shift, 50 percent in the second, and three percent in the third.

In recent years, the proportion of whole-day down time has risen substantially due to malfunctions and unplanned equipment maintenance (down time was 9.5 percent in 1975, 10.2 percent in 1977 and 11.1 percent in 1980). The deterioration in equipment use results from a number of technical, organizational and socioeconomic factors. One reason is the aging of the equipment fleet due to low rates of updating, which leads to an increase in down time for planned and unplanned maintenance.

A significant portion of the down time is associated with the lack of full complements of workers. Thus, for example, the Ministry of Heavy and Transport Machinebuilding failed to meet assignments set for training machine tool operators at its enterprises. The transfer of workers employed in auxiliary jobs to basic production is proceeding too slowly. Higher rates of growth in the fleet of metalworking equipment relative to the growth in the number of workers in machine tool occupations have been noted at a number of enterprises.

Analysis of materials from such studies shows that automated, highly productive equipment is not being used effectively at all enterprises. The Minsk Moped Plant, for example, has specialized lines consisting of five and 18 machine tools which operate only a few days a year. At the Soyuzpod"yemtransmash VPO, the shift index for automatic lines is 1.25; it is 1.04 at the Voroshilovgrad teplovoz PO and 1.33 at the Soyuzvagonmash VPO [railroad locomotive and car production associations].

It should be noted that NPC, heavy-duty and single-purpose machine tools are being used unsatisfactorily, standing idle for considerable periods for technical and organizational reasons connected with imperfections in their designs and controls, with the unreliability of individual subassemblies, with the inadequate number of highly-skilled electronics, programmer and trouble-shooter specialists, with the lack of blanks and programs, and with their improper operation. In small-series production, the NPC machine tool load coefficient averages 0.4 to 0.6 and the shift index is less than 1.3 to 1.6. Thus, for example, the NPC machine tool shift index at Gidrosila Plant imeni 25th CPSU Congress (Kirovograd) is 1.1; it is 1.15 at Leningrad Metals Plant PO. This naturally has an effect on worker labor productivity as well.

A significant portion of the loss of working time is connected with shortcomings in labor and production organization, with sloppy work by dispatcher services and material-technical supply services, with shortcomings in organizing production planning, with gaps in deliveries of assembly components, materials, blanks, tools, and so on. Thus, a survey made on 19 May 1982 showed that 19 metal-cutting machine tools on the No 3 shop conveyor at the Perm Mineshaft Machinebuilding Plant (Soyuzgormash VPO) were not operated at all due to a lack of parts being supplied on a cooperative basis, while this production facility has a full complement of machine tool operators on all three shifts.

One positive example would be the Soyuzneftemash VPO, where the equipment shift index has risen constantly as a result of continuous work along this line. Each plant in the association regularly analyzes equipment use and works out normative shift indices for metalworking equipment in basic production for five-year periods. Thus, the Baku Machinebuilding Plant imeni Lt. Schmidt improved its shift index from 1.38 to 1.72 between 1969 and 1982; Kishlinskiy Machinebuilding

Plant improved from 1.48 to 1.74, and Baku Petroleum Refining Machinebuilding Plant imeni P. Montin improved from 1.26 to 1.80 during these same years. These high results were made possible by the development and implementation of organizational, technical and social measures at each association enterprise.

Currently, 25-30 percent of all the machinery and equipment available in industry is concentrated in machinebuilding, where the shift index is only 1.37, that is, the equipment is operated an average of 10-11 hours of each 24. For this reason, the country's labor collectives must work persistently to increase equipment operation throughout the week, to raise the machinery and equipment shift index, and to bring the available production and scientific-technical potential to bear fully and effectively on resolution of the tasks set by the 26th Party Congress and the December (1983) and subsequent CPSU Central Committee Plenums.

This five-year plan, it has been proposed that the equipment operation shift index in machinebuilding be raised to 1.6. Particular importance is attached to increasing the shift index for the most efficient machinery and mechanisms. Along with this, industry has been set the task of attaining the planned increment in production volume at existing enterprises with fewer workers. For machinebuilding as a whole, the continued development and introduction of advanced experience associated with improving equipment and workstation use at such machinebuilding enterprises as the Novokramatorskiy Machinebuilding Plant PO, Sumi Machinebuilding Association imeni M. V. Frunze PO and Dnepropetrovsk Combine Plant imeni K. Ye. Voroshilov are of important significance.

Thus, machinebuilding enterprises have reserves for raising the equipment shift index. They must be actualized. It is especially important to carry out the measures aimed at reducing equipment down time and intrashift losses of working time.

11052
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INDUSTRY PLANNING AND ECONOMICS

UDC 658.310.3:621
658.310.168:621

SURVEY OF PLANT MANAGEMENT SYSTEMS REVEALS NEED OF ASUP

Moscow MASHINOSTROITEL' in Russian No 11, Nov 84 p 36

[Article by Candidate of Economic Sciences A. G. Titov under rubric "Economics, Effectiveness, Quality": "Management of Intensification of Machine building"]

[Text] Analysis of the operation of machine-building plants and associations makes it possible to reveal organizational and functional shortcomings in management, draw up suggestions aimed at improving its organization, and on that basis to enhance the effectiveness of utilization of the production potential. An analysis of the managerial activity of production shop supervisory personnel (shop superintendents and their deputies) revealed that in the course of performing their duties they must daily resolve from 47 to 75 various technical, organizational, economic, and socio-psychological problems. Such a diversity of problems, which have to be solved within a short time, is not conducive to optimal decision-making.

To establish common features and regularities in the organization of the work of shop superintendents and their deputies, analyses were carried out of the performance of 357 employees at 18 plants and associations in the automobile, electronic, and road, municipal and heavy machine-building industries. For this, all their functions were divided into three groups: work associated with the main production process; work associated with technical preparation and maintenance of production; work associated with the resolution of economic, socio-psychological, and other problems.

It was found that shop superintendents spent on average 51.5 percent of their working time on resolving arising problems associated with the production process, whereas the immediate supervisors (their deputies for production), whose duty it is to resolve those problems, spent only 48.65 percent of their time on them. Moreover, deputy shop superintendents for production preparation and maintenance spent 37.2 percent of their time on performing their immediate functional duties.

Thus, the amount of work duplicated by some supervisory personnel exceeded 50 percent, while the content of the managerial information generated by them was

27 to 33 percent duplicated or triplicated, resulting in unproductive labor in both production and management. Furthermore, the workload of personnel within the same category included a considerable amount of incidental labor in analogous jobs, which is indicative of shortcomings in job regulation. Thus, the time spent by shop superintendents on work associated with organization of the production process ranged from 23.7 to 79.3 percent, or 3.3-fold, and 5-fold on work associated with socio-economic and other problems. It follows that the organization of the work of shop superintendents and their deputies is poorly regulated, there is considerable duplication in their work, and they have inadequate knowledge of the scientific principles of organization of production, labor and management. Similar results were obtained in analyses of the work of other employees of plant (association) departments and services.

The experience acquired in industry shows that managerial activity is most fully characterized by nine basic functions, which are analogous for all subdivisions and employees: planning, bookkeeping, analysis, control, accountability, management, interdependence, rights, and responsibility. Each function assumes a certain list of jobs. Thus, in the economic planning department the greatest amount of work is associated with planning economic indicators (deadlines, quantities, etc.) for subdivisions and services of the plant (association). The control function provides for methods of monitoring compliance with planned indicators. The regulations governing the operations of all structural subdivisions are described in accordance with the functions. Thus, for example, the terms of reference of the economic planning department cover 215 jobs.

Such a functional approach assures:

Clearcut identification of the jobs performed by each supervisor and subdivision, which makes it possible to reduce duplication of managerial functions;

Reduction of the volume of redundant (duplicating) information;

Raising the quality of managerial decisions, their justification and timely implementation;

Improvement of the forms and methods of raising qualifications, taking into account the specifics of functional operations;

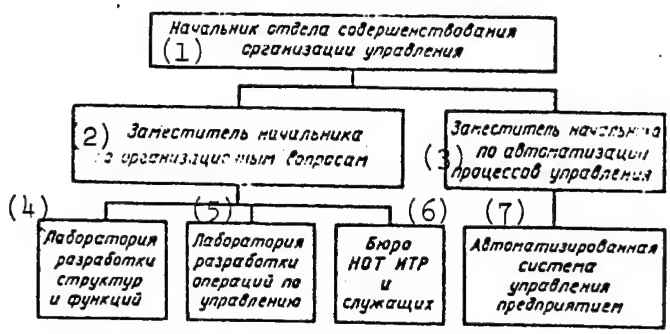
Development of optimal organizational structures of management of subdivisions on the basis of functional duties assigned to each of their elements;

Optimal conditions for estimating the number of workers required for performing each function, by each element.

All this makes it possible to raise the level of organization of management and, consequently, the effectiveness of utilization of the production potential. The functional approach also creates opportunities for further improving management on the basis of elaborating the operations for each functional job. Such an approach makes it possible to coordinate the system of work

planning and performance for each function and among all structural subdivisions and levels of the managerial hierarchy of the plant (association). Practical experience and research confirm the need for the establishment in plants (associations) of subdivisions designed to improve the organization of management. Such subdivisions can be set up by redistributing personnel made redundant by the introduction of the functional approach to management.

The chart shows the structure of a managerial improvement department. A key element of the department is an automated system of plant management.



<u>Key</u>:

1. Chief, Department for Improving Management Organization
2. Deputy Chief for Organizational Questions
3. Deputy Chief for Automation of Managerial Processes
4. Structures and Functions Laboratory
5. Managerial Operations Laboratory
6. Bureau for Scientific Organization of Work of Engineers, Technicians and Office Workers
7. Automated Enterprise Management System

In accordance with current and projected requirements, its functions include the following tasks:

Elaboration of functional duties of subdivisions and personnel and description of jobs falling within each function;

Maintenance of the necessary flexibility of organizational structures of management to assure their quick impact on changes in production;

Methodological guidance of work aimed at improving management of the plant, association, and subdivisions;

Raising the level of scientific organization of work of engineering, technical and office personnel;

Raising the level of automation and mechanization of managerial processes and the document processing system;

Elaboration and implementation of measures aimed at reducing management costs.

The cost of setting up a department for improving managerial organization pays off within 18 months to two years. The introduction of organizational and functional elements in managerial activity makes it possible to intensify job performance and thus raise the effectiveness of managerial work. Thus, at the Bryansk Automobile Plant Production Association, job specification for each functional element helped raise the intensity of work of personnel in the main bookkeeping department and save material, labor and financial resources. At the Leningrad Production Association "Zvezda", the functional duties of the economic services (economic planning, bookkeeping, labor and wages, and finance departments) were worked out and coordinated for each element, thereby raising the effectiveness of their impact on the results of the association's operations.

9681
CSO: 1828/128

METAL-CUTTING AND METAL-FORMING MACHINE TOOLS

ADVANCES IN CUTTING TOOL TECHNOLOGY EXAMINED

Leningrad VECHERNIY LENINGRAD in Russian 19 Nov 84 p 2

[Article by V. Mezdrogin, docent of the Department of Metal-cutting Machine Tools and Instruments of the Leningrad Mechanics Institute, under the subric "On the Course of Accelerating Scientific and Technical Progress": "A Million Is There for the Taking"]

[Text] Our country has at its disposal the most powerful machine-tool base in the world. Its efficient use is determined in large part by the quality of the cutting tools. Apart from specialized scientific research institutes, almost all plants carry out research with more or less success on reliable, stable and long-lasting tools, which provide the highest productivity of labor under conditions of highest quality processing.

For several years scientific research operations have been performed at the Leningrad Mechanics Institute with the goal of creating new, progressive turning instruments for universal machine tools and machine-tool systems with numerically controlled and flexible automatic production systems. Research has been conducted on the dynamic and thermodynamic processes involved in cutting hard-machined steel and alloys, and a study was performed on the vibration of assembled tools under pressure and cutting into turning and vertical lathes. Much work has been devoted to elaborating design plans for cutters which, in our view , must be combined with quick-change cutting inserts which are durable, vibration-resistant, reliable and can withstand drop-testing during rough finishing.

A range of technologically varied replaceable cutting inserts, which are strengthened in a special housing for body points, has been introduced into the assembly of cutters of the proposed design. Blocks have been devised with both soldered and mechanically strengthened sintered-carbide cutting tips.

All of the new assembled universal cutters represent a unique system of tools, adhering to the principles for classifying lathe tools. This system of cutters includes practically all the type sizes of body holder heights from 25 to 100 mm. Production experiments on a few samples during rough- and semi-finishing of the parts at the Bolshevik plant, and the Izhorskiy Plant imeni A.A. Zhdanov and Nevskiy Plant imeni V.I. Lenin assoications, have showed that

with their use the productivity of labor increases 1.5-2.5 times. As the production experiments show, the Leningrad Mechanics Institute's new assembled universal cutters are not just fit to compete with the best foreign analogues, but can also surpass them in the manufacturing of strong cast and forged billets. Taken as a whole, the new system of cutters can replace practically three-quarters of the normal ones in use for middle, strong, hard and unique turning and vertical lathes. The economic result from their introduction in the Leningrad region alone exceeds 1 million rubles.

The established tool-making specialists--among them, the innovators of the Bol'shevik plant F.I. Nironov, State price laureate V.N. Trutnev, and Candidate of Technical Sciences A.V. Belov, a constant promoter of the new instruments, a lecturer at the Leningrad Home of Scientific-Technical Propaganda, and an engineer at the Nevskiy plant association, and others--can provide positive reports about the new combined universal cutters.

Numerous inquiries about the new tools have already come to the Mechanics Institute from plants in the Urals, Ukraine, Siberia, Moscow and other regions of the country. Unfortunately, the institute not only cannot supply a new instrument, but frequently it must refuse requests, even to transmit documentation for the manufacture of the new instrument.

Today the increase in productivity of labor merits particular attention. Leningrad is resolving this problem in the framework of fulfilling the "Intensification-90" Program. The Mechanics Institute's new system of assembled universal cutters can make a positive contribution to its realization.

The system of assembled universal cutters under examination consists of more than 120 designs of body parts and 400 detachable cutting inserts. It is necessary to emphasize that these are designs, and not type sizes. For creation of each such design new research, experiments and additional machinery are necessary. Completion of the whole cycle of these operations now takes almost a year. Today such a pace for introducing progressive tools does not suit anybody.

The Mechanics Institute has taken upon itself all the scientific-technical work necessary to disseminate its system of new turning tools. The Bolshevik plant, with which the Mechanics Institute has ties of long years' standing on the basis of economic agreements, is actively involved in assimilating and elaborating these tools. Mechanical engineers of the Izhorskiy plant and Nevskiy plant associations work together with the Institute in the framework of agreements on creative cooperation. Hard work is being undertaken at these enterprises to introduce the new cutters. With their help the power machine builders intend to speed up sharply the machining of a series of unique, large-size parts from hard-finished steel.

Furthermore, despite their own extreme needs for the new cutters, today far from all of the enterprises are involved in the elaboration and introduction of new combined cutters by the Mechanics Institute. Not even every large plant ventures to create in the instrument department a special engineering group for mastery of the scientific potential to elaborate new tools.

For a successful solution to the problem, which arises in connection with the necessity for widespread dissemination of the new combined cutters to all interested plants in the country, it is expedient to create a special laboratory with scientific-research and design sub-divisions in the Mechanics Institute. The basic tasks of the laboratory shall be: for the scientific leadership to secure and elaborate all examples of cutting systems; to shape and determine the circulation of design documents; to establish the inventor's control over the mastery and application of new cutters; to coordinate operations in all machine-building plants interested in their introduction; to perform the most far-reaching scientific research on and to perfect not only turning but also drilling, milling and other tooling techniques for universal machine tools, machine tools with NC and GAP (flexible automation production).

Simultaneously with the implementation of this organizational step a rational path toward production of new combined cutters should be found. The basic scope of manufacturing operations (preparation of the body cutters, for example) would best be fulfilled by the specialized tools plants. A part of the general scope of operations can be supplied by the large plants with developed tools production. With this it is necessary to think through carefully the system of interrelations between the collectives, the new cutter manufacturers and the principles of their material stimulation.

Such a path of assimilating progressive, universal combined cutters fully answers the demands for the utmost intensification of production.

12926
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ADVANCED NON-TRADITIONAL MACHINE TOOLS ON DISPLAY

Moscow MASHINOSTROITEL' in Russian No 11, Nov 84 pp 41-42

[Article by I. S. Vitol' under rubric "At the USSR Economic Achievements Exhibition": "New Materials Machining Equipment"]

[Text] A display of state-of-the-art electrophysical and electrochemical machining equipment has been set up at the Experimental Scientific Research Institute of Metal-Cutting Machine Tools (ENIMS) Electrophysical and Electrochemical Machining Consultation and Information Center in the Machine Building Pavilion of the Exhibition of Achievements of the National Economy.

The display was organized under a topical exhibit program coordinated with the Exhibition's Topics and Methods Department and approved by the USSR Ministry of the Machine Tool and Tool Building Industry. Contributors to the display, besides this ministry, include eight other ministries, 17 scientific research institutes and 14 plants. The display covers an area of 800 square meters and features 270 exhibits, including operating machine tools and generators, devices, accessories, and samples of machined parts.

With the purpose of defining trends in the development and modernization of equipment and processes, as well as of coordinating work in the field of electrophysical and electrochemical machining methods, the exhibition regularly sponsors seminars and meetings of developers, technologists, electrical-discharge machining (EDM) experts, factory-floor workers, and representatives of leading customer plants. At advanced-experience schools they learn to operate new equipment, including numerically controlled (NC) machine tools, and are familiarized with new manufacturing processes. In 1983, the annual economic effect of the operation of this ENIMS center totaled approximately two million rubles.

The Kirovakan Precision Machine Tools Plant is displaying its model 4531F3 NC EDM machine designed for machining irregular cavities in dimensions of 100x60 mm in hard alloys and other electrically conductive materials difficult to machine by other methods. The machine is used to manufacture the working elements of blanking, bending, upsetting, and drawing dies, form tools, and other items. Cutting is achieved by a continuously moving wire electrode (made of brass, molybdenum, tungsten, or copper) 0.02-0.2 mm in diameter,

submerged in kerosene or water with anticorrosion additives. Power is provided by a type GKI-250 short pulse generator. The machine is controlled by the Kontur 2P-67 NC unit, which is a pulsed, stepped system with linear contour interpolation.

The ENIMS Scientific-Production Association has developed an EDM process for machining closed, irregular-shaped channels in the manufacture of shrouded turbine rotors. It utilizes a multi-electrode tracing mechanism mounted on a universal broaching machine and provides simultaneous machining in converging directions. The process includes programmed electrical-discharge cutting of a set of electrode tools and templates, followed by multiple-tool shaping using the EDM-cut tool set on the tracing mechanism. The process achieves a considerable increase in service life of parts, a 1.5- to 2-fold increase in machining productivity, a 2/3 reduction in consumption of electrode tools, and annual savings of 100,000 rubles.

Another machine developed by ENIMS is the model MA4462F3 machine tool for cutting odd-shaped parts from brittle materials (e.g., quartz glass or special ceramics) with a diamond wire tool which is in reciprocating motion along its axis while rotating around it. The machine is equipped with an NC unit, a photocopying control system, and a device for moving the machined part up and down. Maximum dimension of the contouring operation is 180x100 mm, tool diameter is 0.2-0.5 mm (including the diamond coating), rotation frequency is 40,000-100,000 rpm, machining speed is 2-3 mm per minute, surface roughness R a = 1.25 microns. Annual economic effect of its introduction is 25,000 rubles.

Also developed by ENIMS is an EDM process for cutting odd-shaped parts with straight generating lines from hard alloys and steels using an electrolyte wire in weak electrolytes. As compared with EDM in a working fluid based on water with triethanolamine and sodium nitrite, the new technology makes it possible to reduce corrosive action on the part during prolonged treatment (more than a shift), it increases labor productivity 1.5- to 2-fold, and improves machined surface quality. Introduction of the new technology yields 10,000 rubles annual savings.

The Moscow Special Design Office for EDM Automation and Control Systems developed, and the Kirovakan Precision Machine Tools Plant is building, the model 4A731 machine tool for EDM cutting of odd-shaped parts 160x100 mm in size from hard ceramometallic alloys and other electrically conductive materials. Parts are machined according their drawings, the contours of which are traced by an electrical contact tracing system. The machine is used in tool manufacture, instrument building and electronics for manufacturing parts of small dies. It is equipped with digital displacement indicators. Machining precision is 0.02 mm, productivity is doubled, and the annual economic effect is 5,000 rubles.

The Zaporozhye Motorostroitel' [motor building] Production Association imeni 50-Letiye Velikoy Oktyabr'skoy Sotsialisticheskoy Revolyutsii has developed and built a machine for electrical contact machining of parts from refractory materials. Large parts (600x200 mm) are immersed completely in liquid, which precludes light and sonic radiation. A lifting bath is used for this. A

tracing system assures assigned, steady tool feed. The disk electrode is 170 mm in diameter and rotates at 3,000 rpm, while the faceplate rotates at 25, 50, 75, or 100 rpm. Operating voltage is 24-32 v, and maximum operating current is 3,000 amperes. Introduction of this machine tool increases labor productivity 8-10-fold.

The Special Technical Design Office for Relays and Automation imeni 50-Letiye SSSR has developed a process for machining small hard-alloy dies for models SN138, 4GZh, and ShA03A fast automatic presses employing automated electrical machining methods. The process is implemented on serial models 4B32F3, 4732F3, 4531, and 4D722V machine tools with NC and adaptive control. It produces high-quality dies capable of operating at rates of 500 double strokes per minute without subsequent manual finishing. Annual savings resulting from the introduction of the new technology amount to 200,000 rubles.

The Vitebsk Special Design Office for Gear-Cutting, Grinding, and Tool-Grinding Machine Tools, jointly with ENIMS, developed the model 3V624 semiautomatic diamond-erosion machine tool for finished grinding of the trailing face of hard-alloy and brazed high-speed turning and planing tool tips 12 to 50 mm in height. With accessory mechanisms it is also possible to grind the leading edge of cutting tools and to plane-sharpen hard-alloy and high-speed drills 5 to 32 mm in diameter. Thanks to its extensive universality, the machine replaces models 3Ye624, 3Ye624E, and 3Ye624ER machine tools. Grinding productivity is increased 1.4-fold, and burning, microcracking and chipping of ground tools are precluded in all machining modes. Annual economic effect is 18,000 rubles.

The Vitebsk Special Design Office is also represented at the display with the model OSh-226 plane-grinding diamond-erosion machine, built by the Krasnyy Borets Machine-Tool Plant in Orsha. The machine is designed for grinding parts 630x200x320 mm in size made of refractory materials. It is equipped with a one-coordinate NC system and a set of mechanisms (straightening electrode, tracing electromechanical drive, pulsed-voltage generator) for stabilizing the grinding capability of the wheel with the help of electrical discharges. The tracing system is implemented on the basis of an electromechanical drive and ensures automatic maintenance of the set intensity of electrical-discharge action on the wheel outside the cutting zone. Programmed removal of machining allowance and the capability for cyclic processing of parts makes it possible to increase grinding productivity 2- to 5-fold. Wheel durability is increased 5- to 10-fold, electricity consumption is reduced 20 to 30 percent, and roughness of machined surface is 1.25 microns.

The Scientific Institute of Automobile Transportation has developed the model EPV-2000M installation for preliminary electrochemical treatment for final grinding of the screw profile of hardened ball circulating screws (diameter 30-90 mm, maximum length 2,200 mm). The method consists in circular electrochemical drawing by a special electrode tool while the blank is rotated and the electrode tool feed is axially synchronized. Annual economic effect is 105,500 rubles.

ENIMS has developed a highly productive, no-fault diamond-EDM external circular grinding process for cylindrical single-crystal cast and spray-coated

tungsten parts. The process is based on continuous or periodic action of electrical discharges on the working surface of a diamond wheel to prevent loading and uncover new working grains. The grinding cycles are continuous diamond-erosion and diamond with initial electrical-discharge dressing. The recommended machine tools for this are cylindrical grinding machines modernized for diamond erosion and the 3K12R and VT-82 diamond-erosion machines. Introduction of this process raises labor productivity 1.5- to 1.7-fold, eliminates wheel dressing, precludes spoilage due to chipping, burning and microcracking, cuts electricity consumption by 25-30 percent, and reduces temperature in the cutting zone by 33-50 percent. Annual economic effect per machine tool is 50,000 rubles.

The All-Union Scientific Research Institute of Gas Welding and Cutting Equipment displays its Iskra-2.5 P1 microcomputerized NC machine for plasma shaping of parts from sheet metal. The use of microcomputer technology makes it possible to automate the cutting process, raise labor productivity 1.2-1.3-fold, increase precision three-fold, and to simultaneously cut direct and mirror-reflected shapes from one or several sheets. Annual machining capacity of 40-mm steel sheet is 6,000-7,000 tons. The annual economic effect per machine is 50,000 rubles.

ENIMS's Stankokonstruktsiya plant has built the model 4R222F2 program-controlled laser-beam machine for three-dimensional machining of refractory materials, including diamonds, ceramics, and composite materials. It can drill holes 0.05-0.3 mm in diameter in electrode systems of gas-discharge instruments and aviation parts, cut holes and slots of almost any desired shape in ceramic microcomputer circuit boards, and machine multifaceted tools from superhard materials. Holes are cut to a depth of up to 3 mm by a beam from a solid-state ruby laser using two beam-localization circuits. The machine is equipped with a multifunctional NC system which controls the movement of a stepped-drive table, accessories, and the diaphragm. Annual savings yielded by its introduction are 48,600 rubles.

9681
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AUTOMATED LINES AND AGGREGATED MACHINING SYSTEMS

UDC 061.3:006.01

STATUS OF FLEXIBLE PRODUCTION TECHNOLOGY SURVEYED

Moscow STANDARTY I KACHESTVO in Russian No 4, Apr 85 pp 6-9

[Article by V. F. Kurochkin, Yu. Ya. Vengerovskiy and P. A. Shalayev, candidates of technical sciences (VNIINMASH) "Basic Principles of Standardization of Flexible Production Systems"]

[Text] Editor

Automation of Production and Robot Equipment

In February, a plenary session was held in the Gosstandart of the Scientific Technological Council [NTS] which considered the basic principles of automatic complexes and flexible automation productions [GAP]. Besides that, the council heard information about the results of the work of the NTS in 1984 and the problems for 1985. V. F. Kurochkin, director of the VNIINMASH [All-Union Scientific Research Institute for Standardization in Machinebuilding] gave his report, (the article on the report and the NTS solution are published below). The following participated in the discussion of the report. Deputy director of the ENIMS [Experimental Scientific Research Institute of Metal-Cutting Machine Tools], V. A. Kudinov; department manager of the Moscow Machine Tool and Tool Institute, V. V. Pavlov; deputy chief engineer of the Atomic Power Institute imeni I. V. Kurchatov, Gnedenko; deputy chief of the Main Technical Administration of the Ministry of the Radio Industry, P. I. Zavalishin; manager of the NIAT sector, M. F. Idzon, etc.

Decrees of the 26th party congress and of the following plenums of the CPSU Central Committee determined that automation of production as one of the most important directions in intensifying the development of the national economy. The industry was given the problem of increasing the output of machine systems for comprehensive mechanization and automation of production, creating automatic shops and plants by the wide use of manipulators (industrial robots), high productivity equipment and built-in systems of automatic control with microprocessors and minicomputers.

In the eighth section are concentrated norm documents for regulating requirements of complementing GPS products, such as electrical motors and control systems, and the system for lubrication and feeding lubrication-cooling liquids.

The last, ninth, section includes the development of norm documents which regulate the reliability norms of GPS and its individual components, and methods for insuring the operating reliability.

The program project involves the development of 30 state standards and 70 guiding documents.

The GPS standardization program being developed must, on one hand, provide methodological unity of GPS development and create conditions for unit-module design of systems from standard components, as well as for industrial manufacturing and circulating the latter, and provide for the functioning of various levels of GPS, while on the other hand, it must control the development of those standardization programs and systems of standards in whose framework GPS objects are being standardized.

In this connection, it is necessary to review general technical system standards for the YeSTPP [Single System for Technical Preparation for Production], ESKD [Single System for Design Documentation], YeSTD [Single System for Technological Documentation] and make them to correspond to the requirements of flexible automatic production.

Some 19 ministries and departments were given the task of implementing the programs of comprehensive GPS standardization. They were entrusted with solving specific problems. In particular, the ministries are to develop norm documents:

The Minstankoprop [Ministry of Machine Tool and Tool Industry] -- for GPS machining, forge-press and casting, plating and assembly of general machine-building programs, and for coordinate-measuring and layout machines for GPS; for metal-cutting and auxiliary tools for GPS equipment; for hydropneumatic drives and hydropneumatic apparatus for GPS;

The Minpribor [Ministry of Instrument building Automation Facilities and Control Systems] -- for GPS control and diagnostic systems, including technical devices, languages, software and data;

The Minelektrotekhprom [Ministry of Electrical Equipment Industry and Power Machinery Building] -- for GPS for arc welding, electrothermal plasma machining, electrical robot cars for GPS, standardized electrical motors for various purpose GPS; including automatic transport-warehousing and materials handling equipment;

The Mintyazhmash [Ministry of Heavy and Transport Machinebuilding] -- for GPS transport and warehousing equipment;

The Minavioprom [Ministry of Aviation Industry] together with the Gosstandart -- within the framework of the YeSTPP norm documents for technological preparation of flexible automatic production.

the output of equipment whose productivity is only higher than that of the old equipment by 10 to 20 percent and increase thereby the output-capital ratio of the equipment.

It is important to accelerate the development of standards and their provision to industry. The present practice is to create norm documents for GPS and the SAPR, began more frequently to contain temporary specifications (VTU) and temporary general technical requirements (VOTT), developed by specially created working groups of leading scientists and specialists in a short period of time. Later, state standards will be prepared on usual schedules on the basis of the approved VTU and VOTT.

Thus, GOST 26228-84 "Flexible production systems. Terms and definitions" was developed and approved, using a VTU as a basis. This standard regulates not only the basic terms, but also lays the classification bases for GPS, separates GPS kinds according to levels of organizational structure and GPS kinds according to automation stages.

On the basis of the indicated special features of GPS standardization, as well as proposals of industrial sectors, a program was formulated for GPS standardization which includes nine sections.

The first section of the program covers the creation of a state standard complex and guiding documents that regulate GPS classification, methods for calculating the economic efficiency, the order of developing and introducing systems, indicators and methods for evaluating the quality of GPS.

Standardization of the GPS technological bases (second section of the program) includes the development of a set of norm documents, that regulate requirements to typicalization and grouping of products manufactured in GPS, requirements for the ease of manufacture of the designs, the order of technological design, the requirements to the technological GPS components, types and basic parameters of the readjustable modules and types of automatic transport-housing systems.

The basis of the third and fourth sections of the program are norm documents regulating typical structures of GPS, typical groupings of GPS for various kinds of machining, typical sets of metal machining equipment, fixtures and tools for GPS.

The fifth and sixth sections of the program technical norm documents regulate requirements to the composition and structure of typical software for GPS, requirements of control systems, interfaces and communications channels between technological GPS components and computers.

The technical norm documentation for regulating preventive maintenance rules, the order of diagnosing and monitoring GPS components, requirements of diagnostic and monitoring devices make up the basis for the seventh section of the program.

This program was being developed in accordance with the decree of the USSR Council of Ministers "On accelerating the work on automation of machinebuilding production on the basis of advanced technological processes and flexible readjustable complexes." The decree directed theGosstandart and the Ministry of the Machine Tool and Tool Industry together with the interested USSR ministries and departments to develop in 1984-1986 technical norm documentation for standardization of flexible automatic production modules and systems, industrial robots and complementing products for them.

The complexity and the specifics of flexible production systems determined the special features of standardization directions in this area.

1. Standardization of requirements to interface between components in the systems and their high reliability. Standardization of interfaces which would insure their language, program, tool, communications and mechanical compatibility of the components in the system.

2. Standardization of the program-methodological complexes (PMK). PMK standardization will make it possible to solve the circulation problem of software. Today, it is possible to find hundreds of practically the same software on which specialists of various departments worked independently of each other. Software standardization will make it possible to use in various GPS well-finished typical software independently of their departmental affiliation, which will reduce considerably developments.

3. Establishment of high reliability requirements for all GPS components and their balance. Not meeting these requirements leads to inefficient GPS operation.

According to sources abroad, great attention is given to the reliability of GPS and its components. Specialists of the United States Robot Institute single out on pages of the "Robot Equipment Today" magazine four basic factors to this problem as follows:

high skilled repair specialists should be assigned for their operation;

a sufficient quantity and kind of spare parts should be provided;

high standards of preventive maintenance should be provided;

there should be competition between manufacturers.

Japanese, American and other firms set one hour as the time for eliminating any defects. Naturally, to keep this time norm is only possible with strict observance of the first three factors.

4. The small experience accumulated in our country and abroad requires setting new standards. for equipment development organizations - the lower limit for the productivity of new equipment with respect to the existing equipment. For example, the bottom productivity parameters of a new machine tool should be higher by 50 percent than that of the existing machine tool. This must eliminate

production combine. It consists of robots created in Bulgarian enterprises and NC machine tools made by the Moscow "Krasnyy proletariy" Plant.

In our country, since 1975, work was done in a number of industrial sectors on creating automatic productions for manufacturing parts of various types. Two approaches were used: in one case -- the creation at specialized enterprises of new automatic technological complexes released to the customer "by turning over the key", while in the other -- the creation of automatic complexes on the basis of the existing machining equipment at the enterprise.

Machine tool building industry enterprises under the guidance of the ENIMS developed an automatic complex for machining solids of revolution type parts and a family of automatic sections for rough, semifinished and finished machining of housing parts in small series production.

An automatic shop is operating successfully for several years at the Dnepropetrovsk Electrical Locomotive Plant. Here are installed NC machine tools, robots-manipulators and devices for removing chips. Warehouses and intrashop transport are also automated. All subdivisions are controlled electrically. A computer does the operational planning and provides work positions with tools and intermediate products. In several minutes, the shop can change over to the output of any of 370 parts manufactured here.

Typical flexible automatic systems are developed also for other plants with their subsequent adaptation to experimental and single piece production conditions.

Efficient GPS development and introduction is impossible without large scale work on standardization. Specialists of leading capitalist countries speak of the need of standardization.

An analysis of the literature indicated that at the level of national standardization, the most widely developed was basically the work on standardizing GPS components as equipment, industrial robots, NC systems, measuring, monitoring and diagnostic devices.

Another object of national standardization are means of interaction between the man and the computer (in design, control and manufacturing), such as graphic interaction languages, software for NC, etc. An important object for national standardization are also programing and data facilities for the SAPR [CAM].

Based on experience abroad and the experience of leading sectors of our industry, the VNIINMASH together with the representatives of the industry developed a program for the GPS standardization.

The goal of this program is the creation of a single technical norm basis that would insure a high technical standard, a unit-module GPS design, the specialization in manufacturing of highly reliable GPS components, GP modules and typical GAP.

At the same time, basic attention should be given to accelerating automation of machinebuilding which determines the industrial potential of the country and the technical standard of all sectors of the national economy.

Questions of automation in machinebuilding must be solved, primarily, in series production which today makes up about 70 percent of the total machinebuilding output.

The main attention should be directed toward the creation and introduction of flexible production systems (GPS) with a high level of automation, industrial robots and computers.

GPS must provide the following: high productivity of labor, speedy readjustment of production, a considerably higher acceleration of schedules of assimilating new products by comprehensive automation of all links of the production process, including the preparation of the design and technological documentation, preparation and planning production, etc. All of that, essentially, must lead to the creation of the so-called "unmanned technology."

The GPS concept is being expanded to complicated production systems, automatic enterprises and automatic plants, as well as to their structural components; automatic shops, automatic and robotized sections, readjustable automatic lines with flexible and robotized complexes.

The GPS basis are NC equipment, robots, microprocessors and other components. The number of such components, according to published data, is increasing continuously. Thus, while in 1975, there were 8000 robots in the world, in 1980 the number increased to 30,000 and in 1990, it will approach 300,000. Its basic part will be robots of the third generation with the so-called "artificial intelligence." Microprocessors are also developing dynamically. In 1980, about 250 million microprocessor systems and devices operated in the world.

Let us trace the GPS development in countries abroad. According to the FMS Magazine (October 1982), the total number of GPS in the world was 145 with 60 of them in Japan. The GPS were basically designed for machining housing parts and solids of revolution type parts. Thus, in Japan, 80 percent of GPS, of the 53 analyzed (analysis made by English specialists), were designed for machining housing parts and 20 percent -- for solids of revolution type parts. A trend was noted to the use of compact (small with respect to the number of machine tools) GPS. In the United States, most GPS were designed for machining various housing parts with an annual program of 3000 to 100,000 units annually. Sweden has eight GPS. The most interesting of them has 20 NC machine tools and three machining centers operating 24 hours per day (at night without people).

The course on creating "unmanned" enterprises was taken also by CEMA member countries. In Czechoslovakia, flexible sections for machining solids of revolution and housing parts operate in one of the machine tool building enterprises of an association. They are controlled by computer lines created on the basis of cooperation within the CEMA framework. A GPS operates at an NRB scientific

Taking into account the importance of the given program for developing domestic machinebuilding, ministries and departments participating in its formation and implementation must monitor strictly the execution of the enumerated work.

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AUTOMATED LINES AND AGGREGATED MACHINING SYSTEMS

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DESIGNING FLEXIBLE MACHINING CELLS AS SUBSYSTEMS OF FMS

Moscow MASHINOSTROITEL' in Russian No 11, Nov 84 pp 9-10

[Article by candidates of technical sciences V. G. Serebrennyy and V. N. Karyakin: "Certain Aspects of the Development of Flexible Manufacturing Systems"]

[Text] Implementation of a policy of intensifying and increasing the effectiveness of social production in every way possible requires the retooling of the basic branches of industry. The development of the material-technical base for such retooling is the responsibility of machinebuilding, and first of all of machine tool manufacturing, is base and leading branch.

The status and level of development of these branches has a decisive influence on the overall rates of economic growth in the country and on accelerating the rates of scientific-technical progress. The demand for rapid, effective restructuring of production to manufacture new output determines the necessity of changing machinebuildin g over from the automation of individual operations and links of the production process to comprehensive automation of all of its levels, to the massive involvement of flexible, highly efficient machine systems based on NPC equipment, industrial robots, microprocessor control and computers.

Under these conditions, the development of flexible production systems (GPS) has become a most important national economic task. The extensive use of GPS is the basis for solving the problem of accelerating scientific-technical progress and increasing production efficiency. Dozens of GPS are already operating in plants here. In the years ahead, their numbers must be increased many-fold. In this connection, the search for optimum technical resolutions for such systems and ways of developing them and using them effectively takes on special importance.

GPS design and their introduction into series production is a complex, labor-intensive task requiring the interlinked solving of such problems as the development of technological processes, the selection of structural-layout resolutions, the development of the basic designs for machinery, tooling, instrumentation and control systems, and finally, organizing the operation of such systems for a changing structure and duration of the processes being performed at individual workstations.

Under these conditions, the traditional approach to creating GPS, similar to that of the design task of interfacing existing machine tools and auxiliary installations, turns out to be unsuitable. The fact that the GPS consists of multiple units and the large number of combinations of technological processes lead to an abundance of possible structural-layout resolutions, on which the basic technical requirements of all elements of these systems depends to a substantial extent. Therefore, the considerable capital investments required to develop and create GPS make the task of purposefully planning systems which are optimal in terms of structure and equipment composition especially urgent. The specifics of this task consist in planning GPS, like any large system, with the thorough development of variants using the potential of modern computer equipment. Under these conditions, the most important and most complex stages of GPS technical planning, those which determine the effectiveness of subsequent use of these systems, are shifted to earlier stages of development, to those preceding the designing of specific machines and units.

The main feature of large systems is the manifestation in them of new qualities absent in their individual elements. In this regard, qualitative changes occur not with just any quantitative accumulation of individual elements, but only with an aggregate which is accompanied by profound changes both in their composition and in the structure of the whole system. The properties of the system change not only under the impact of changes in the composition of individual system links and in the structure of the whole system, but also under the impact of changes in the nature of its interrelationships with its surroundings. This leads to the necessity of evaluating, at the stage in which the fundamental planning resolutions of the GPS structural variants are chosen, the technical-economic effectiveness of the functioning of the system as a whole based on the multiplicity of criteria which make it inappropriate to use all of them to evaluate the effectiveness of its individual elements. Such an evaluation must take into account the impact of introducing a particular technical resolution on all stages of social production. For example, when automating production, the impact affects both the process of manufacturing automatic equipment and means of automation and the process of operating automated equipment and using the output of an automated production facility. Consequently, the conditions for improving the economic effectiveness of new equipment are embedded not only in that branch developing and using the equipment, but also in related branches. Thorough recording of the enterprise's interests in introducing GPS and evaluating the effectiveness of using new equipment from the viewpoint of the national economy eliminate the possibility of creating ineffective, local resolutions obtained on the basis of encompassing a small number of existing factors. The present level of equipment development enables us to automate practically any stage of machinebuilding production, but this in no way signifies that automation is always appropriate. It is effective only if expenditures on creating it are substantially less than the national economic impact of its use.

A most important requirement of the methodology of GPS engineering planning is the ability to examine such systems not only as independent systems, but also as subsystems of some larger system, in order to delineate all existing ties and factors and evaluate their effects. Underevaluation of any important individual factors can lead to a situation in which a partial gain within a subsystem framework may turn into substantial losses for the national economy as a whole.

One example of this kind is the traditional partial automation of series production based on automatic and special machine tools. A reduction in cyclical losses on such machine tools permitted a reduction in the time spent on readjustment when changing the type of parts being processes and led to the necessity of processing parts in lots. This provided enterprises with an opportunity to achieve an increase in such important indicators as quantitative release of parts and equipment load factors. All this played a positive role at a certain stage.

The obvious advantages of this approach led to its being disseminated everywhere. Moreover, there were successful attempts to transplant the ideology of production in lots to small-series and even individual production. The parts-specialized (object-closed) sectors and production facilities created on a base of group technology and typified technological processes permitted a substantial increase in the seriality of parts production, approximating this form of production organization to the flow-line type inherent to large-series and mass production. Under these conditions, ensuring the even, smooth release of finished commodity output turned out to be very much more difficult. Production organization based on release in lots, a consequence of partial automation, led in turn to changes in the structure of technological processes and equipment such that realizing the even release of finished items containing complete sets of parts in a variable products list turned out to be possible only given the accumulation of significant stocks of parts in enterprise warehouses.

Thus, one direct consequence of such automation of small-series production, which did permit an increase in the effectiveness of equipment operation, was a sharp reduction in the effectiveness of enterprise operation as a whole, due to the enormous amounts of unfinished production. Moreover, this entailed the inefficient use of production space to store surplus parts, it had an effect on losses due to failure to meet delivery schedules for assembly components under cooperative agreements, and so forth.

The empirical nature of GPS development on a basis of engineering intuition by "trial and error" and the development of systems based on engineering art, but not engineering science, which are permissible in the initial stages of establishing a new direction of automation but which are inappropriate and ineffective given the extensive industrial utilization of GPS, have by no means always led to desireable results. Therefore, the task of forming an ideology, of determining the principles, methods, models, structures, algorighms and technical means which can appropriately be used in developed systems, moves to the fore.

The necessity of jointly reviewing a broad range of interlinked problems at the GPS planning and use stages makes it appropriate to broaden exploratory work along the following lines:

-- design, including automated planning of basic output (items) -- production targets;

-- technological, ensuring the development of progressive new technological processes and using them as a basis for planning highly-productive equipment which will perform working and auxiliary operations without direct human participation;

-- organizational, anticipating the automated resolution of questions of planning, organizing and managing production, monitoring basic and auxiliary processes, diagnosing machine operation, and so on;

-- technical-economic, examining the optimization of basic indicators for evaluating GPS technical resolutions.

The stage of mathematical and imitational modeling [simulation], done in the early stages of planning, acquires particular importance when developing GPS. In this stage, the multiplicity of permissible GPS structural-layout resolutions are shaped on a base of the joint review of initial assignment structures, technological processes, and optimal forms of production organization given a variable products list of items. Substantiation and selection of an optimal resolution must be based on the use of modern optimization methods. This stage, which concludes with the development of mathematical programming, is necessary to resolve the tasks of synthesizing efficient GPS structures for concrete production conditions.

Inasmuch as GPS is an aggregate of substantially different links, we must ensure their interaction under coordinated working conditions. The requirement of systems compatibility necessitates the presence in each link of qualities which determine not only its own content, but also the overall result of the actions of other links. Change and improvement in one link require change and improvement in other links. For this reason, design studies of individual GPS mechanisms and installations can be made only after concluding all the research stages reviewed, that is, shifting from the initial development phases, as was typical in traditional planning of machines, to the concluding stage. This work organization and sequence will enable us to concentrate the efforts of leading specialists on solving the most important and most labor-consuming part of the problem, that of developing a methodology for the engineering planning of optimum GPS structural-layout resolutions with consideration of the number of operating positions, types and forms of transport between machine tools, intermachine storage unit capacities, and so forth.

The unit-module principle of GPS construction, standard software and the methodology of engineering calculations are the basis which will help developers plan and create a system of any degree of flexibility, required productivity and configuration, for actual industrial use conditions in the shortest possible time using standard GPS.

The present level of GPS equipment development and the opportunities for actualizing machine tool programmable readjustment create the prerequisites for developing flexible automated production facilities (GAP) [FMS: flexible manufacturing systems in USA] which combine several GPS (including ones for various technological redistributions) designed for processing parts in complete sets for items. The solution to the problem is based on organizing GPS element spatial and temporal ties and local GPS within a single GAP as will permit synchronizing the operation of all elements and subsystems given a changing products list of parts.

The construction of such systems provides an opportunity to organize flow-line production designed for the smooth release of small series without the need for

accumulating stocks of parts prior to assembly. This will permit, while retaining or even slightly increasing the tempo of parts release (and given a high equipment load) a substantial increase in the release of finished items at existing enterprises, making them more effective, creating conditions for smooth deliveries on a cooperative basis, and substantially increasing the mobility and effectiveness of industry as a whole.

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AUTOMATED LINES AND AGGREGATED MACHINING SYSTEMS

FLEXIBLE PRODUCTION SYSTEM CUTS MANPOWER IN HALF

Moscow MEKHANIZATSIYA I AVTOMATIZATSIYA PROIZVODSTVA in Russian No 3, Mar 85 pp 2-3

[Article by Engineer V. D. Spivak and Candidate Technical Sciences V.V. Trukhin: "Flexible Production System for the Mechanical Machining of Parts"]

[Text] At the Darasun plant for mining equipment a flexible system for production (see illustration) is being used for the purposes of:

integrated machining of parts with a high degree of automation of the mechanical technological processes,

shortening the duration of the production cycle,

reducing the amount of unfinished production,

reducing the number of production personnel,

increasing the effectiveness of controlling production processes, and

making possible rapid changes of the articles being produced.

For machining on the GPS [Flexible Production System] the following parts were selected: shafts, pinion shafts, flanges, covers, and stocks with a diameter up to 400 mm and a length up to 800 mm and a weight of up to 20 kg. The output of each of the designated parts is from dozens to several thousand pieces. The maximum production program is 150,000 parts per year. The GPS consists of an automated transport and storage system (the ATSS), an automated system for controlling the production process (the ASUTP), and a set of high-productivity metal-cutting equipment.

The ATSS is for accumulating, storing, and distributing blanks, tools, machine-tool attachments, and technical documentation on the operation of the technological processes of mechanical machining; and it is for issuing finished parts for transport to the assembly shop. It consists of an automatic crane, a two-row, three-tier shelved storage, an automatic chain roller conveyor for loading and unloading, conveyor stations, a central control console, and consoles for control from work places.

The total capacity of the ATSS storage is 407 compartments. Of them, 93 are used for the stowage of tools and fixtures and for the inputting of the conveyor stations.

The ATSS is controlled from a computer during operation in the automatic mode and by means of the consoles of the work places or the central control console during semiautomatic operation. The mode of control is designated depending on the production conditions and potentialities.

Use of the Automatic System for the Control of the Production Process [ASUTP] permits increasing the output of products because of raising the coefficient of loading the equipment. It improves the effective control of the production process. It reduces losses of working time, frees workers, and allows the efficient organization of transportation traffic. This is achieved by automating the interoperation transport of parts, automating accounting, monitoring and planning, and automating the collection of current information.

The ASUTP of the GPS [Flexible Production System] consists of the following subsystems; namely, planning and accounting and the control of the ATSS. The realization of these subsystems has permitted carrying out control of the production process in a fundamentally new way, increasing the effectiveness of control and the soundness of control decisions.

A model SM1-4 control computer and a complex of peripheral equipment serves as the basis operation of the GPS in the automatic mode.

The ASUTP software permits the solution of the following problems:

calculation of the starting batch,

composition of the per-shift loading of the equipment and the per-shift assignments, and also the per-shift assignment for the preparation of fixtures, cutting and measuring tools,

monitoring for a deviation from an assured supply of blanks,

keeping records of parts shipped from the GPS,

monitoring the fulfillment of planned assignments,

keeping records of rejects, and

controlling the automated transport and storage system.

The number of parts following a routine mechanical machining operation is verified at the monitoring station of the GPS. Information on the quality of the manufactured parts and the quantity of them in the container is introduced into the system by means of a display module situated at the monitoring station.

The flexible production system [GPS] is fitted with loudspeakers and a telephone system.

The technological process for machining parts is based on the use, in the principal forming operations which are the most labor-intensive, of progressive metal-cutting equipment.

The following are used in the GPS: machine tools with ChPU [Numerically Programmed Controls] - models 1734F3, 1751F3 and 16K20F3, machine tools with cyclic controls - SP403, 1708Ts, 1716Ts, and gear-cutting and grinding semiautomatic machines. In all, 32 machine tools are installed.

Chips are carried away by automatic conveyors mounted under the flexible production system.

The production system is working on two shifts and in each shift is being served by: a computer operator, an operator of the central control console of the ATSS, an on-duty electronics engineer, and 12 machine tool operators. In all - 15 persons.

The introduction of the production system at the Darasun plant for mining equipment has permitted obtaining an economic gain of above 450,000 rubles, has reduced the number of production personnel by 29 persons, has lowered the duration of the production cycle by 15 percent, and has decreased the amount of unfinished production by 14 percent.

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